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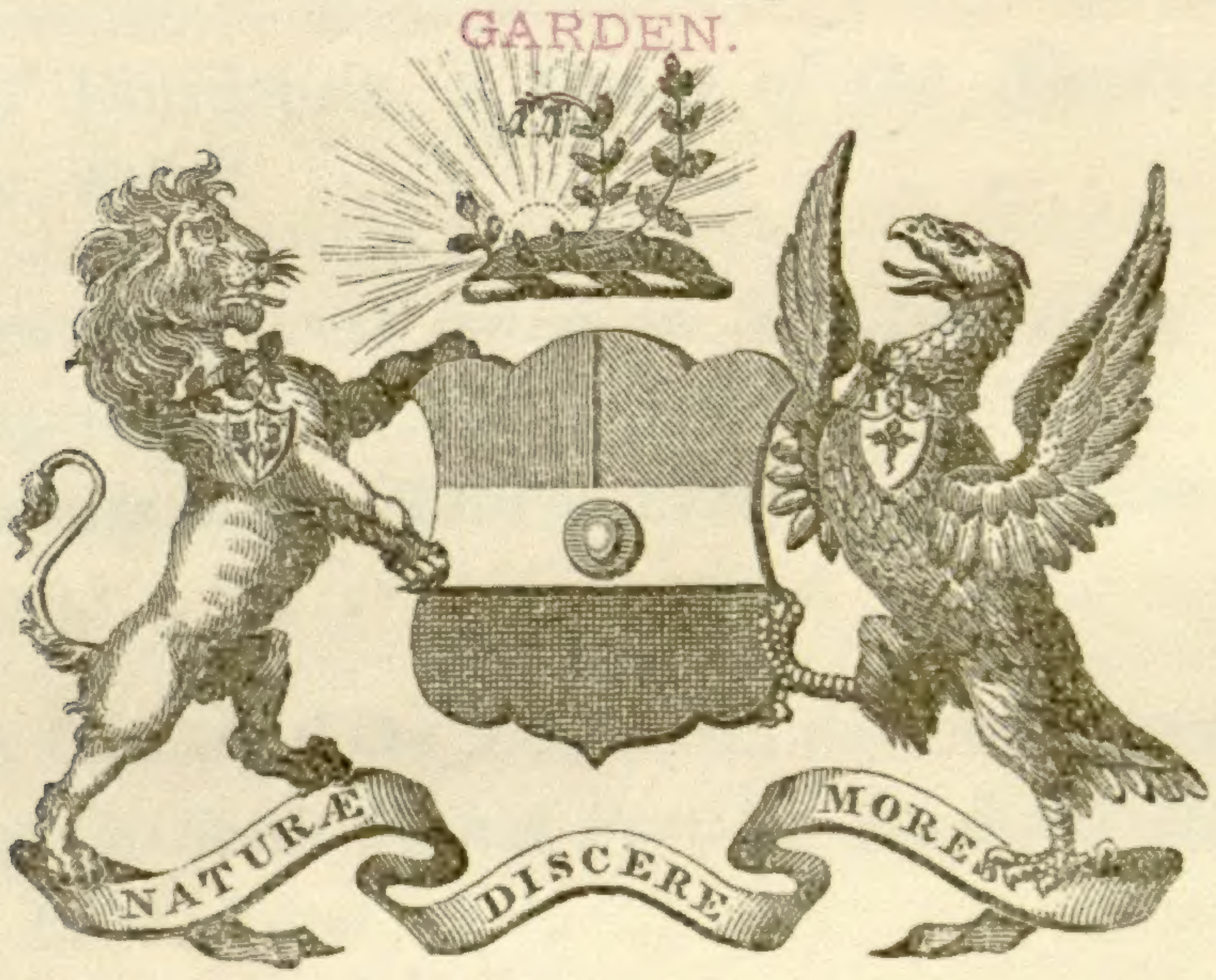
OF
LONDON.

VOLUME XXV.

MISSOURI
BOTANICAL
GARDEN.



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PART THE FIRST.

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I. *On the Phenomena of Variation and Geographical Distribution as illustrated by the* Papilionidæ *of the Malayan Region. By* Alfred R. Wallace, *Esq.*

(Plates I.–VIII.)

Read March 17, 1864.

WHEN the naturalist studies the habits, the structure, or the affinities of animals, it matters little to which group he especially devotes himself; all alike offer him endless materials for observation and research. But, for the purpose of investigating the phenomena of geographical distribution and of local or general variation, the several groups differ greatly in their value and importance. Some have too limited a range, others are not sufficiently varied in specific forms, while, what is of most importance, many groups have not received that amount of attention over the whole region they inhabit, which could furnish materials sufficiently approaching to completeness to enable us to arrive at any accurate conclusions as to the phenomena they present as a whole. It is in those groups which are and have long been favourites with collectors that the student of distribution and variation will find his materials the most satisfactory, from their comparative completeness.

Preeminent among such groups are the diurnal Lepidoptera or Butterflies, whose extreme beauty and endless diversity have led to their having been assiduously collected in all parts of the world, and to the numerous species and varieties having been figured in a series of magnificent works, from those of Cramer, the contemporary of Linnæus, down to the inimitable productions of our own Hewitson. But, besides their abundance, their universal distribution, and the great attention that has been paid to them, these insects have other qualities that especially adapt them to elucidate the branches of inquiry already alluded to. These are the immense development and peculiar structure of the wings, which not only vary in form more than those of any other insects, but offer on both surfaces an endless variety of pattern, colouring, and texture. The scales with which they are more or less completely covered imitate the rich hues and delicate surfaces of satin or of velvet, glitter with metallic lustre, or glow with the changeable tints of the opal. This delicately painted surface acts as a register of the minutest differences of organization,—a shade of colour, an additional streak or spot, a slight modification of outline continually recurring with the greatest regularity and fixity, while the body and all its other members exhibit no appreciable change. The wings of Butterflies, as Mr. Bates has well put it*, "serve as a tablet on which Nature writes the story of the modifications of species;" they enable us to perceive changes that would otherwise be uncertain and difficult of observation, and exhibit to us on an enlarged scale the effects of the climatal and other physical conditions which influence more or less profoundly the organization of every living thing.

A proof that this greater sensibility to modifying causes is not imaginary may, I think, be drawn from the consideration that while the Lepidoptera as a whole are of all insects the least essentially varied in form, structure, or habits, yet in the number of their specific forms they are not much inferior to those orders which range over a much wider field of nature, and exhibit more deeply seated structural modifications. The Lepidoptera are all vegetable-feeders in their larva-state, and suckers of juices or other liquids in their perfect form. In their most widely separated groups they differ but little from a common type, and offer comparatively unimportant modifications of structure or of habits. The Coleoptera, the Diptera, or the Hymenoptera, on the other hand, present far greater and more essential variations. In either of these orders we have both vegetable- and animal-feeders, aquatic, and terrestrial, and parasitic groups. Whole families are devoted to special departments in the economy of nature. Seeds, fruits, bones, carcases, excrement, bark, have each their special and dependent insect tribes from among them; whereas the Lepidoptera are, with but few exceptions, confined to the one function of devouring the foliage of living vegetation. We might therefore anticipate that their population would be only equal to those of the sections of the other orders that have a similar uniform mode of existence; and the fact that their numbers are at all comparable with those of entire orders, so much more varied in organization and habits, is, I think, a proof that they are in general highly susceptible of specific modification.

The Papilionidæ are a family of diurnal Lepidoptera which have hitherto, by almost universal consent, held the first rank in the order; and though this position has recently been denied them, I cannot altogether acquiesce in the reasoning by which it has been proposed to degrade them to a lower rank. In Mr. Bates's most excellent paper on the Heliconidæ†, he claims for that family the highest position, chiefly because of the imperfect structure of the fore legs, which is there carried to an extreme degree of abortion, and thus removes them further than any other family from the Hesperidæ and Heterocera, which all have perfect legs. Now it is a question whether any amount of difference which is exhibited merely in the imperfection or abortion of certain organs, can establish in the group exhibiting it a claim to a high grade of organization; still less can this be allowed when another group, along with perfection of structure in the same organs, exhibits modifications peculiar to it, together with the possession of an organ which in the remainder of the order is altogether wanting. This is, however, the position of the Papilionidæ. The perfect insects possess two characters quite peculiar to them. Mr.

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* See 'The Naturalist on the Amazons,' 2nd edit. p. 412.

† Transactions of the Linnean Society, vol. xxiii. p. 495.

Edward Doubleday, in his 'Genera of Diurnal Lepidoptera,' says, "The Papilionidæ may be known by the apparently four-branched median nervule and the spur on the anterior tibiæ, characters found in no other family." The four-branched median nervule is a character so constant, so peculiar, and so well marked, as to enable a person to tell, at a glance at the wings only of a butterfly, whether it does or does not belong to this family; and I am not aware that any other group of Butterflies, at all comparable to this in extent and modifications of form, possesses a character in its neuration to which the same degree of certainty can be attached. The spur on the anterior tibiæ is also found in some of the Hesperidæ, and is therefore supposed to show a direct affinity between the two groups; but I do not imagine it can counterbalance the differences in neuration and in every other part of their organization. The most characteristic feature of the Papilionidæ, however, and that on which I think insufficient stress has been laid, is undoubtedly the peculiar structure of the larvæ. These all possess an extraordinary organ situated on the neck, the well-known Y-shaped tentacle, which is entirely concealed in a state of repose, but which is capable of being suddenly thrown out by the insect when alarmed. When we consider this singular apparatus, which in some species is nearly half an inch long, the arrangement of muscles for its protrusion and retraction, its perfect concealment during repose, its blood-red colour, and the suddenness with which it can be thrown out, we must, I think, be led to the conclusion that it serves as a protection to the larva by startling and frightening away some enemy when about to seize it, and is thus one of the causes which has led to the wide extension and maintained the permanence of this now dominant group. Those who believe that such peculiar structures can only have arisen by very minute successive variations, each one advantageous to its possessor, must see, in the possession of such an organ by one group, and its complete absence in every other, a proof of a very ancient origin and of very long-continued modification. And such a positive structural addition to the organization of the family, subserving an important function, seems to me alone sufficient to warrant us in considering the Papilionidæ as the most highly developed portion of the whole order, and thus in retaining it in the position which the size, strength, beauty, and general structure of the perfect insects have been generally thought to deserve.

The Papilionidæ are pretty widely distributed over the earth, but are especially abundant in the tropics, where they attain their maximum of size and beauty and the greatest variety of form and colouring. South America, North India, and the Malay Islands are the regions where these fine insects occur in the greatest profusion, and where they actually become a not unimportant feature in the scenery. In the Malay Islands in particular the giant Ornithopteræ may be frequently seen about the borders of the cultivated and forest districts, their large size, stately flight, and gorgeous colouring rendering them even more conspicuous than the generality of birds. In the shady suburbs of the town of Malacca two large and handsome Papilios (*Memnon* and *Nephelus*) are not uncommon, flapping with irregular flight along the roadway, or, in the early morning, expanding their wings to the invigorating rays of the sun. In Amboyna and other towns of the Moluccas, the magnificent *Deiphobus* and *Severus*, and occasionally even the azure-winged *Ulysses*, frequent similar situations, fluttering about the orange-trees and flower-beds, or sometimes even straying into the narrow bazaars or covered markets of the city. In Java the golden-dusted *Arjuna* may often be seen at damp places on the roadside in the mountain districts, in company with *Sarpedon, Bathycles,* and *Agamemnon,* and less frequently the beautiful swallow-tailed *Antiphates.* In the more luxuriant parts of these islands one can hardly take a morning's walk in the neighbourhood of a town or village without seeing three or four species of *Papilio,* and often twice that number. No less than 120 species of the family are now known to inhabit the Archipelago, and of these ninety-six were collected by myself. Twenty-nine species are found in Borneo, being the largest number in any one island, twenty-three species having been obtained by myself in the vicinity of Sarawak; Java has twenty-seven species; Celebes and the Peninsula of Malacca twenty-three each. Further east the numbers decrease, Batchian producing seventeen, and New Guinea only thirteen, though this number is certainly too small, owing to our present imperfect knowledge of that great island.

In estimating these numbers I have had the usual difficulty to encounter, of determining what to consider species and what varieties. The Malayan region, consisting of a large number of islands of generally great antiquity, possesses, compared to its actual area, a great number of distinct forms, often indeed distinguished by very slight characters, but in most cases so constant in large series of specimens, and so easily separable from each other, that I know not on what principle we can refuse to give them the name and rank of species. One of the best and most orthodox definitions is that of Pritchard, the great ethnologist, who says, that "*separate origin and distinctness of race, evinced by a constant transmission of some characteristic peculiarity of organization,*" constitutes a species. Now leaving out the question of "origin," which we cannot determine, and taking only the proof of separate origin, "*the constant transmission of some characteristic peculiarity of organization,*" we have a definition which will compel us to neglect altogether the *amount* of difference between any two forms, and to consider only whether the differences that present themselves are *permanent.* The rule, therefore, I have endeavoured to adopt is, that when the difference between two forms inhabiting separate areas seems quite constant, when it can be defined in words, and when it is not confined to a single peculiarity only, I have considered such forms to be species. When, however, the individuals of each locality vary among themselves, so as to cause the distinctions between the two forms to become inconsiderable and indefinite, or where the differences, though constant, are confined to one particular only, such as size, tint, or a single point of difference in marking or in outline, I class one of the forms as a variety of the other.

I find as a general rule that the constancy of species is in an inverse ratio to their range. Those which are confined to one or two islands are generally very constant. When they extend to many islands, considerable variability appears; and when they have an extensive range over a large part of the Archipelago, the amount of unstable variation is very large. These facts are explicable on Mr. Darwin's principles. When a species exists over a wide area, it must have had, and probably still possesses, great powers of dispersion. Under the different conditions of existence in various portions of its area, different variations from the type would be selected, and, were they completely isolated, would soon become distinctly modified forms; but this process is checked by the dispersive powers of the whole species, which leads to the more or less frequent intermixture of the incipient varieties, which thus become irregular and unstable. Where, however, a species has a limited range, it indicates less active powers of dispersion, and the process of modification under changed conditions is less interfered with. The species will therefore exist under one or more permanent forms according as portions of it have been isolated at a more or less remote period.

What is commonly called variation consists of several distinct phenomena which have been too often confounded. I shall proceed to consider these under the heads of—1st, simple variability; 2nd, polymorphism; 3rd, local forms; 4th, coexisting varieties; 5th, races or subspecies; and 6th, true species.

1. *Simple variability.*—Under this head I include all those cases in which the specific form is to some extent unstable. Throughout the whole range of the species, and even in the progeny of individuals, there occur continual and uncertain differences of form, analogous to that variability which is so characteristic of domestic breeds. It is impossible usefully to define any of these forms, because there are indefinite gradations to each other form. Species which possess these characteristics have always a wide range, and are more frequently the inhabitants of continents than of islands, though such cases are always exceptional, it being far more common for specific forms to be fixed within very narrow limits of variation. The only good example of this kind of variability which occurs among the Malayan Papilionidæ is in *Papilio Severus*, a species inhabiting all the islands of the Moluccas and New Guinea, and exhibiting in each of them a greater amount of individual difference than often serves to distinguish well-marked species. Almost equally remarkable are the variations exhibited in most of the species of *Ornithoptera*, which I have found in some cases to extend even to the form of the wing and the arrangement of the nervures. Closely allied, however, to these variable species are others which, though differing slightly from them, are constant and confined to limited areas. After satisfying oneself, by the examination of numerous specimens captured in their native countries, that the one set of individuals are variable and the others are not, it becomes evident that by classing all alike as varieties of one species we shall be obscuring an important fact in nature, and that the only way to exhibit that fact in its true light is to treat the invariable local form as a distinct species, even though it does not offer better distinguishing characters than do the extreme forms of the variable species. Cases of this kind are the *Ornithoptera Priamus*, which is confined to the islands of Ceram and Amboyna, and is very constant in both sexes, while the allied species inhabiting New Guinea and the Papuan Islands is exceedingly variable; and in the island of Celebes is a species closely allied to the variable *P. Severus*, but which, being exceedingly constant, I have described as a distinct species under the name of *Papilio Pertinax*.

2. *Polymorphism or dimorphism.*—By this term I understand the coexistence in the same locality of two or more distinct forms, not connected by intermediate gradations, and all of which are occasionally produced from common parents. These distinct forms generally occur in the female sex only, and the intercrossing of two of these forms does not generate an intermediate race, but reproduces the same forms in varying proportions. I believe it will be found that a considerable number of what have been classed as

varieties are really cases of *polymorphism.* Albinoism and melanism are of this character, as well as most of those cases in which well-marked varieties occur in company with the parent species, but without any intermediate forms. Under these circumstances, if the two forms breed separately, and are never reproduced from a common parent, they must be considered as distinct species, contact without intermixture being a good test of specific difference. On the other hand, intercrossing without producing an intermediate race is a test of dimorphism. I consider, therefore, that under any circumstances the term 'variety' is wrongly applied to such cases.

The Malayan Papilionidæ exhibit some very curious instances of polymorphism, some of which have been recorded as varieties, others as distinct species; and they all occur in the female sex. *Papilio Memnon*, L., is one of the most striking, as it exhibits the mixture of simple variability, local and polymorphic forms, all hitherto classed under the common title of varieties. The polymorphism is strikingly exhibited by the females, one set of which resemble the males in form, with a variable paler colouring; the others have a large spatulate tail to the hinder wings and a distinct style of colouring, which causes them closely to resemble *P. Coon*, a species of which the sexes are alike and inhabiting the same countries, but with which they have no direct affinity. The tailless females exhibit simple variability, scarcely two being found exactly alike even in the same locality. The males of the island of Borneo exhibit constant differences of the under surface, and may therefore be distinguished as a local form, while the continental specimens, as a whole, offer such large and constant differences from those of the islands that I am inclined to separate them as a distinct species—*P. Androgeus*, Cr. We have here, therefore, distinct species, local forms, polymorphism, and simple variability, which seem to me to be distinct phenomena, but which have been hitherto all classed together as varieties. I may mention that the fact of these distinct forms being one species is doubly proved. The males, the tailed and tailless females, have all been bred from a single group of the larvæ, by Messrs. Payen and Bocarmé, in Java, and I myself captured in Sumatra a male *P. Memnon*, L., and a tailed female *P. Achates*, Cr., "in copulâ."

Papilio Pammon, L., offers a somewhat similar case. The female was described by Linnæus as *P. Polytes*, and was considered to be a distinct species till Westermann bred the two from the same larvæ (see Boisduval, 'Species Générales des Lépidoptères,' p. 272). They were therefore classed as sexes of one species by Mr. Edward Doubleday, in his 'Genera of Diurnal Lepidoptera,' in 1846. Later, female specimens were received from India closely resembling the male insect, and this was held to overthrow the authority of M. Westermann's observation, and to reestablish *P. Polytes* as a distinct species; and as such it accordingly appears in the British Museum List of Papilionidæ in 1856, and in the Catalogue of the East India Museum in 1857. This discrepancy is explained by the fact of *P. Pammon* having two females, one closely resembling the male, while the other is totally different from it. A long familiarity with this insect (which, replaced by local forms or by closely allied species, occurs in every island of the Archipelago) has convinced me of the correctness of this statement; for in every place where a male allied to *P. Pammon* is found, a female resembling *P. Polytes* also occurs, and sometimes, though less frequently than on the continent, another female closely resembling the male; while not only has no male specimen of *P. Polytes* yet been found, but the female (*Polytes*) has never yet been found in localities to which the male (*Pammon*) does not extend. In this case, as in the last, distinct species, local forms, and dimorphic specimens have been confounded under the common appellation of varieties.

But, besides the true *P. Polytes*, there are several allied forms of females to be considered, namely, *P. Theseus*, Cr., *P. Melanides*, De Haan, *P. Elyros*, G. R. G., and *P. Romulus*, L. The dark female figured by Cramer as *P. Theseus* seems to be the common and perhaps the only form in Sumatra, whereas in Java, Borneo, and Timor, along with males quite identical with those of Sumatra, occur females of the *Polytes* form, although a single specimen of the true *P. Theseus*, Cr., taken at Lombock would seem to show that the two forms do occur together. In the allied species found in the Philippine Islands (*P. Alphenor*, Cr., *P. Ledebouria*, Eschsch., ♀ *P. Elyros*, G. R. G.) forms corresponding to these extremes occur along with a number of intermediate varieties, as shown by a fine series in the British Museum. We have here an indication of how dimorphism may be produced; for let the extreme Philippine forms be better suited to their conditions of existence than the intermediate connecting links, and the latter will gradually die out, leaving two distinct forms of the same insect, each adapted to some special conditions. As these conditions are sure to vary in different districts, it will often happen, as in Sumatra and Java, that the one form will predominate in the one island, the other in the adjacent one. In the island of Borneo there seems to be a third form; for *P. Melanides*, De Haan, evidently belongs to this group, and has all the chief characteristics of *P. Theseus*, with a modified coloration of the hind wings. I now come to an insect which, if I am correct, offers one of the most interesting cases of variation yet adduced. *Papilio Romulus*, L., a butterfly found over a large part of India and Ceylon, and not uncommon in collections, has always been considered a true and independent species, and no suspicions have been expressed regarding it. But a male of this form does not, I believe, exist. I have examined the fine series in the British Museum, in the East India Company's Museum, in the Hope Museum at Oxford, in Mr. Hewitson's and several other private collections, and can find nothing but females; and for this common butterfly no male partner can be found except the equally common *P. Pammon*, a species already provided with two wives, and yet to whom we shall be forced, I believe, to assign a third. On carefully examining *P. Romulus*, I find that in all essential characters,—the form and texture of the wings, the length of the antennæ, the spotting of the head and thorax, and even the peculiar tints and shades with which it is ornamented,—it corresponds exactly with the other females of the *Pammon* group; and though, from the peculiar marking of the fore wings, it has at first sight a very different aspect, yet a closer examination shows that every one of its markings could be produced by slight and almost imperceptible modifications of the various allied forms. I fully believe, therefore, that I shall be correct in placing *P. Romulus* as a third Indian form of the female *P. Pammon*, corresponding to *P. Melanides*, the third form of the Malayan *P. Theseus*. I may mention here that the females of this group have a superficial resemblance to the *Polydorus* group, as shown by *P. Theseus* having been considered to be the female of *P. Antiphus*, and by *P. Romulus* being arranged next to *P. Hector*. There is no close affinity between these two groups of *Papilio*, and I am disposed to believe that we have here a case of mimicry, brought about by the same causes which Mr. Bates has so well explained in his account of Heliconidæ, and which thus led to the singular exuberance of polymorphic forms in this and allied groups of the genus *Papilio*. I shall have to devote a section of my paper to the consideration of this subject.

The third example of polymorphism I have to bring forward is *Papilio Ormenus*, Guér., which is closely allied to the well-known *P. Erechtheus*, Don., of Australia. The most common form of the female also resembles that of *P. Erechtheus*; but a totally different-looking insect was found by myself in the Aru Islands, and figured by Mr. Hewitson under the name of *P. Onesimus*, which subsequent observation has convinced me is a second form of the female of *P. Ormenus*. Comparison of this with Boisduval's description of *P. Amanga*, a specimen of which from New Guinea is in the Paris Museum, shows the latter to be a closely similar form; and two other specimens were obtained by myself, one in the island of Goram and the other in Waigiou, all evidently local modifications of the same form. In each of these localities males and ordinary females of *P. Ormenus* were also found. So far there is no evidence that these light-coloured insects are not females of a distinct species, the males of which have not been discovered. But two facts have convinced me this is not the case. At Dorey, in New Guinea, where males and ordinary females closely allied to *P. Ormenus* occur (but which seem to me worthy of being separated as a distinct species), I found one of these light-coloured females closely followed in her flight by three males, exactly in the same manner as occurs (and, I believe, occurs only) with the sexes of the same species. After watching them a considerable time, I captured the whole of them, and became satisfied that I had discovered the true relations of this anomalous form. The next year I had corroborative proof of the correctness of this opinion by the discovery in the island of Batchian of a new species allied to *P. Ormenus*, all the females of which, either seen or captured by me, were of one form, and much more closely resembling the abnormal light-coloured females of *P. Ormenus* and *P. Pandion* than the ordinary specimens of that sex. Every naturalist will, I think, agree that this is strongly confirmative of the supposition that both forms of female are of one species; and when we consider, further, that in four separate islands, in each of which I resided for several months, the two forms of female were obtained and only one form of male ever seen, and that about the same time M. Montrouzier in Woodlark Island, at the other extremity of New Guinea (where he resided several years, and must have obtained all the large Lepidoptera of the island), obtained females closely resembling mine, which, in despair at finding no appropriate partners for them, he mates with a widely different species,—it becomes, I think, sufficiently evident that this is another case of polymorphism of the same nature as those already pointed out in *P. Pammon* and *P. Memnon*. This species, however, is not only *dimorphic*, but *trimorphic*; for, in the island of Waigiou, I obtained a third female quite distinct from either of the others, and in some degree intermediate between the ordinary female and the male. The specimen is particularly interesting to those who believe, with Mr. Darwin, that extreme difference of the sexes has been gradually produced by what he terms sexual selection, since it may be supposed to exhibit one of the intermediate steps in that process which has been accidentally preserved in company with its more favoured rivals, though its extreme rarity (only one specimen having been seen to many hundreds of the other form) would indicate that it may soon become extinct.

The only other case of polymorphism in the genus *Papilio*, at all equal in interest to those I have now brought forward, occurs in America; and we have, fortunately, accurate information about it. *Papilio Turnus*, L., is common over almost the whole of temperate North America; and the female resembles the male very closely. A totally different-looking insect both in form and colour, *Papilio Glaucus*, L., inhabits the same region; and though, down to the time when Boisduval published his 'Species Général,' no connexion was supposed to exist between the two species, it is now well ascertained that *P. Glaucus* is a second female form of *P. Turnus*. In the 'Proceedings of the Entomological Society of Philadelphia,' Jan. 1863, Mr. Walsh gives a very interesting account of the distribution of this species. He tells us that in the New England States and in New York all the females are yellow, while in Illinois and further south all are black; in the intermediate region both black and yellow females occur in varying proportions. Lat. 37° is approximately the southern limit of the yellow form, and 42° the northern limit of the black form; and, to render the proof complete, both black and yellow insects have been bred from a single batch of eggs. He further states that, out of thousands of specimens, he has never seen or heard of intermediate varieties between these forms. In this interesting example we see the effects of latitude in determining the proportions in which the individuals of each form should exist. The conditions are *here* favourable to the one form, *there* to the other; but we are by no means to suppose that these conditions consist in climate alone. It is highly probable that the existence of enemies, and of competing forms of life, may be the main determining influences; and it is much to be wished that such a competent observer as Mr. Walsh would endeavour to ascertain what are the adverse causes which are most efficient in keeping down the numbers of each of these contrasted forms.

Dimorphism of this kind in the animal kingdom does not seem to have any direct relations to the reproductive powers, as Mr. Darwin has shown to be the case in plants, nor does it appear to be very general. One other case only is known to me in another family of my eastern Lepidoptera, the *Pieridæ*; and but few occur in the Lepidoptera of other countries. The spring and autumn broods of some European species differ very remarkably; and this must be considered as a phenomenon of an analogous though not of an identical nature *. *Araschnia prorsa*, of Central Europe, is a striking example of this alternate or seasonal dimorphism. Mr. Pascoe has pointed out two forms of the male sex in some species of Coleoptera belonging to the family Anthribidæ, in seven species of the two genera *Xenocerus* and *Mecocerus* (Proc. Ent. Soc. Lond., 1862, p. 71); and no less than six European Water-beetles, of the genus *Dytiscus*, have females of two forms, the most common having the elytra deeply sulcate, the rarer smooth as in the males. The three, and sometimes four or more, forms under which many Hymenopterous insects (especially Ants) occur must be considered as a related phenomenon, though here each form is specialized to a distinct function in the economy of the species. Among the higher animals, albinoism and melanism may, as I have already stated, be considered as analogous facts; and I met with one case of a bird, a species of Lory (*Eos fuscata*, Blyth), clearly existing under two forms, since I obtained both sexes of each from a single flock.

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* Among our nocturnal Lepidoptera, I am informed, many analogous cases occur; and as the whole history of many of these has been investigated by breeding successive generations from the egg, it is to be hoped that some of our British Lepidopterists will give us a connected account of all the abnormal phenomena which they present.

The fact of the two sexes of one species differing very considerably is so common, that it attracted but little attention till Mr. Darwin showed how it could in many cases be explained by what he termed sexual selection. For instance, in most polygamous animals the males fight for the possession of the females, and the victors, always becoming the progenitors of the succeeding generation, impress upon their male offspring their own superior size, strength, or unusually developed offensive weapons. It is thus that we can account for the spurs and the superior strength and size of the males in Gallinaceous birds, and also for the large canine tusks in the males of fruit-eating Apes. So the superior beauty of plumage and special adornments of the males of so many birds can be explained by supposing (what there are many facts to prove) that the females prefer the most beautiful and perfect-plumaged males, and that thus slight accidental variations of form and colour have been accumulated till they have produced the wonderful train of the Peacock and the gorgeous plumage of the Bird of Paradise. Both these causes have no doubt acted partially in insects, so many species possessing horns and powerful jaws in the male sex only, and still more frequently the males alone rejoicing in rich colours or sparkling lustre. But there is here another cause which has led to sexual differences, viz. a special adaptation of the sexes to diverse habits or modes of life. This is well seen in female Butterflies (which are generally weaker and of slower flight), often having colours better adapted to concealment; and in certain South American species (*Papilio torquatus*) the females, which inhabit the forests, resemble the *Æneas* group, which abound in similar localities, while the males, which frequent the sunny open river-banks, have a totally different coloration. In these cases, therefore, natural selection seems to have acted independently of sexual selection; and all such cases may be considered as examples of the simplest dimorphism, since the offspring never offer intermediate varieties between the parent forms.

The distinctive character therefore of dimorphism is this, that the union of these distinct forms does not produce intermediate varieties, but reproduces them unchanged. In simple varieties, on the other hand, as well as when distinct local forms or distinct species are crossed, the offspring never resembles either parent exactly, but is more or less intermediate between them. Dimorphism is thus seen to be a specialized result of variation, by which new physiological phenomena have been developed; the two should therefore, whenever possible, be kept separate*.

3. *Local form, or variety.*—This is the first step in the transition from variety to species.

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* The phenomena of *dimorphism* and *polymorphism* may be well illustrated by supposing that a blue-eyed, flaxen-haired Saxon man had two wives, one a black-haired, red-skinned Indian squaw, the other a woolly-headed, sooty-skinned negress—and that instead of the children being mulattoes of brown or dusky tints, mingling the separate characteristics of their parents in varying degrees, all the boys should be pure Saxon boys like their father, while the girls should altogether resemble their mothers. This would be thought a sufficiently wonderful fact; yet the phenomena here brought forward as existing in the insect-world are still more extraordinary; for each mother is capable not only of producing male offspring like the father, and female like herself, but also of producing other females exactly like her fellow-wife, and altogether differing from herself. If an island could be stocked with a colony of human beings having similar physiological idiosyncrasies with *Papilio Pammon* or *Papilio Ormenus*, we should see

It occurs in species of wide range, when groups of individuals have become partially isolated in several points of its area of distribution, in each of which a characteristic form has become segregated more or less completely. Such forms are very common in all parts of the world, and have often been classed as varieties or species alternately. I restrict the term to those cases where the difference of the forms is very slight, or where the segregation is more or less imperfect. The best example in the present group is *Papilio Agamemnon*, L., a species which ranges over the greater part of tropical Asia, the whole of the Malay archipelago, and a portion of the Australian and Pacific regions. The modifications are principally of size and form, and, though slight, are tolerably constant in each locality. The steps, however, are so numerous and gradual that it would be impossible to define many of them, though the extreme forms are sufficiently distinct. *Papilio Sarpedon*, L., presents somewhat similar but less numerous variations.

4. *Coexisting variety.*—This is a somewhat doubtful case. It is when a slight but permanent and hereditary modification of form exists in company with the parent or typical form, without presenting those intermediate gradations which would constitute it a case of simple variability. It is evidently only by direct evidence of the two forms breeding separately that this can be distinguished from *dimorphism*. The difficulty occurs in *Papilio Jason*, Esp., and *P. Evemon*, Bd., which inhabit the same localities, and are almost exactly alike in form, size, and coloration, except that the latter always wants a very conspicuous red spot on the under surface, which is found not only in *P. Jason*, but in all the allied species. It is only by breeding the two insects that it can be determined whether this is a case of a coexisting variety or of *dimorphism*. In the former case, however, the difference being constant and so very conspicuous and easily defined, I see not how we could escape considering it as a distinct species. A true case of coexisting forms would, I consider, be produced, if a slight variety had become fixed as a local form, and afterwards been brought into contact with the parent species with little or no intermixture of the two; and such instances do very probably occur.

5. *Race, or subspecies.*—These are local forms completely fixed and isolated; and there is no possible test but individual opinion to determine which of them shall be considered as species and which varieties. If stability of form and "*the constant transmission of some characteristic peculiarity of organization*" is the test of a species (and I can find no other test that is more certain than individual opinion), then every one of these fixed races, confined as they almost always are to distinct and limited areas, must be regarded as a species; and as such I have in most cases treated them. The various modifications of *Papilio Ulysses*, *P. Peranthus*, *P. Codrus*, *P. Eurypilus*, *P. Helenus*, &c., are excellent examples; for while some present great and well-marked, others offer slight and inconspicuous differences, yet in all cases these differences seem equally fixed and permanent. If, therefore, we call some of these forms species, and others varieties, we introduce a purely arbitrary distinction, and shall never be able to decide where to draw the line. The races of *Papilio Ulysses*, L., for example, vary in amount of modification from the scarcely differing New Guinea form to those of Woodlark Island and New Caledonia, but

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white men living with yellow, red, and black women, and their offspring always reproducing the same types; so that at the end of many generations the men would remain pure white, and the women of the same well-marked races as at the commencement.

all seem equally constant; and as most of these had already been named and described as species, I have added the New Guinea form under the name of *P. Penelope*. We thus get a little group of Ulyssine Papilios, the whole comprised within a very limited area, each one confined to a separate portion of that area, and, though differing in various amounts, each apparently constant. Few naturalists will doubt that all these may and probably have been derived from a common stock; and therefore it seems desirable that there should be a unity in our method of treating them: either call them all *varieties* or all *species*. Varieties, however, continually get overlooked; in lists of species they are often altogether unrecorded; and thus we are in danger of neglecting the interesting phenomena of variation and distribution which they present. I think it advisable, therefore, to name all such forms; and those who will not accept them as species may consider them as subspecies or races.

6. *Species.*—Species are merely those strongly marked races or local forms which, when in contact, do not intermix, and when inhabiting distinct areas are generally believed to have had a separate origin, and to be incapable of producing a fertile hybrid offspring. But as the test of hybridity cannot be applied in one case in ten thousand, and even if it could be applied, would prove nothing, since it is founded on an assumption of the very question to be decided—and as the test of separate origin is in every case inapplicable—and as, further, the test of non-intermixture is useless, except in those rare cases where the most closely allied species are found inhabiting the same area, it will be evident that we have no means whatever of distinguishing so-called "true species" from the several modes of variation here pointed out, and into which they so often pass by an insensible gradation. It is quite true that, in the great majority of cases, what we term "species" are so well marked and definite that there is no difference of opinion about them; but as the test of a true theory is, that it accounts for, or at the very least is not inconsistent with, the whole of the phenomena and apparent anomalies of the problem to be solved, it is reasonable to ask that those who deny the origin of species by variation and selection should grapple with the facts in detail, and show how the doctrine of the distinct origin and permanence of species will explain and harmonize them. It has been recently asserted by a high authority that the difficulty of limiting species is in proportion to our ignorance, and that just as groups or countries are more accurately known and studied in greater detail the limits of species become settled*. This statement has, like many other general assertions, its portion of both truth and error. There is no doubt that many uncertain species, founded on few or isolated specimens, have had their true nature determined by the study of a good series of examples: they have been thereby established as species or as varieties; and the number of times this has occurred is doubtless very great. But there are other and equally trustworthy cases in which, not single species, but whole groups have, by the study of a vast accumulation of materials, been proved to have no definite specific limits. A few of these must be adduced. In Dr. Carpenter's 'Introduction to the Study of the Foraminifera,' he states that "*there is not a single specimen of plant or animal of which the range of variation has been studied by the collocation and comparison of so large a number of specimens as have passed under the review of Messrs. Williamson, Parker, Rupert Jones, and myself, in our studies of the*

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* See Dr. J. E. Gray "On the Species of Lemuroids," Proc. Zool. Soc. 1863, p. 134.

types of this group;" and the result of this extended comparison of specimens is stated to be, "*The range of variation is so great among the Foraminifera as to include not merely those differential characters which have been usually accounted* SPECIFIC, *but also those upon which the greater part of the* GENERA *of this group have been founded, and even in some instances those of its* ORDERS" (Foraminifera, Preface, x). Yet this same group had been divided by D'Orbigny and other authors into a number of clearly defined *families*, *genera*, and *species*, which these careful and conscientious researches have shown to have been almost all founded on incomplete knowledge.

Professor DeCandolle has recently given the results of an extensive review of the species of *Cupuliferæ.* He finds that the best-known species of oaks are those which produce most varieties and subvarieties, that they are often surrounded by provisional species; and, with the fullest materials at his command, two-thirds of the species he considers more or less doubtful. His general conclusion is, that "*in botany the lowest series of groups*, SUBVARIETIES, VARIETIES, *and* RACES *are very badly limited*; *these can be grouped into* SPECIES *a little less vaguely limited, which again can be formed into sufficiently precise* GENERA." This general conclusion is entirely objected to by the writer of the article in the 'Natural History Review,' who, however, does not deny its applicability to the particular order under discussion, while this very difference of opinion is another proof that difficulties in the determination of species do not, any more than in the higher groups, vanish with increasing materials and more accurate research.

Another striking example of the same kind is seen in the genera *Rubus* and *Rosa*, adduced by Mr. Darwin himself; for though the amplest materials exist for a knowledge of these groups, and the most careful research has been bestowed upon them, yet the various species have not thereby been accurately limited and defined so as to satisfy the majority of botanists.

Dr. Hooker seems to have found the same thing in his study of the Arctic flora. For though he has had much of the accumulated materials of his predecessors to work upon, he continually expresses himself as unable to do more than group the numerous and apparently fluctuating forms into more or less imperfectly defined species*.

Lastly, I will adduce Mr. Bates's researches on the Amazons. During eleven years he accumulated vast materials, and carefully studied the variation and distribution of insects. Yet he has shown that many species of Lepidoptera, which before offered no special difficulties, are in reality most intricately combined in a tangled web of affinities, leading by such gradual steps from the slightest and least stable variations to fixed races and well-marked species, that it is very often impossible to draw those sharp dividing-lines which it is supposed that a careful study and full materials will always enable us to do.

These few examples show, I think, that in every department of nature there occur instances of the instability of specific form, which the increase of materials aggravates rather than diminishes. And it must be remembered that the naturalist is rarely likely to err on the side of imputing greater indefiniteness to species than really exists. There is a completeness and satisfaction to the mind in defining and limiting and naming a species, which leads us all to do so whenever we conscientiously can, and which we know has led many collectors to reject vague intermediate forms as destroying the symmetry of their cabinets. We must therefore consider these cases of excessive variation and instability as being thoroughly well established; and to the objection that, after all, these cases are but few compared with those in which species can be limited and defined, and are therefore merely exceptions to a general rule, I reply that a true law embraces all apparent exceptions, and that to the great laws of nature there are no real exceptions—that what appear to be such are equally results of law, and are often (perhaps indeed always) those very results which are most important as revealing the true nature and action of the law. It is for such reasons that naturalists now look upon the study of *varieties* as more important than that of well-fixed species. It is in the former that we see nature still at work, in the very act of producing those wonderful modifications of form, that endless variety of colour, and that complicated harmony of relations, which gratify every sense and give occupation to every faculty of the true lover of nature.

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* In his paper on the "Distribution of Arctic Plants," Trans. Linn. Soc. xxiii. p. 310, Dr. Hooker says:—

"The most able and experienced descriptive botanists vary in their estimate of the value of the 'specific term' to a much greater extent than is generally supposed."

"I think I may safely affirm that the 'specific term' has three different standard values, all current in descriptive botany, but each more or less confined to one class of observers."

"This is no question of what is right or wrong as to the real value of the specific term; I believe each is right according to the standard he assumes as the specific."

Variation as specially influenced by Locality.

The phenomena of variation as influenced by locality have not hitherto received much attention. Botanists, it is true, are acquainted with the influences of climate, altitude, and other physical conditions in modifying the forms and external characteristics of plants; but I am not aware that any peculiar influence has been traced to locality, independent of climate. Almost the only case I can find recorded is mentioned in that repertory of natural-history facts, 'The Origin of Species,' viz. that herbaceous groups have a tendency to become arboreal in islands. In the animal world, I cannot find that any facts have been pointed out as showing the special influence of locality in giving a peculiar *facies* to the several disconnected species that inhabit it. What I have to adduce on this matter will therefore, I hope, possess some interest and novelty.

On examining the closely allied species, local forms, and varieties distributed over the Indian and Malayan regions, I find that larger or smaller districts, or even single islands, give a special character to the majority of their Papilionidæ. For instance: 1. The species of the Indian region (Sumatra, Java, and Borneo) are almost invariably smaller than the allied species inhabiting Celebes and the Moluccas; 2. The species of New Guinea and Australia are also, though in a less degree, smaller than the nearest species or varieties of the Moluccas; 3. In the Moluccas themselves the species of Amboyna are the largest; 4. The species of Celebes equal or even surpass in size those of Amboyna; 5. The species and varieties of Celebes possess a striking character in the form of the anterior wings, different from that of the allied species and varieties of all the surrounding islands; 6. Tailed species in India or the Indian region become tailless as they spread eastward through the archipelago.

Having preserved the finest and largest specimens of Butterflies in my own collection, and having always taken for comparison the largest specimens of the same sex, I believe that the tables I now give are sufficiently exact. The differences of expanse of wings are in most cases very great, and are much more conspicuous in the specimens themselves than on paper. It will be seen that no less than fourteen Papilionidæ inhabiting Celebes and the Moluccas are from one-third to one-half greater in extent of wing than the allied species representing them in Java, Sumatra, and Borneo. Six species inhabiting Amboyna are larger than the closely allied forms of the northern Moluccas and New Guinea by about one-sixth. These include almost every case in which closely allied species can be compared.

PAPILIONIDÆ.

Species of the Moluccas and Celebes (large).	Expanse. inches.	Closely allied species of Java and the Indian region (small).	Expanse. inches.
Ornithoptera Helena (Amboyna)	7·6	O. Pompeus	5·8
		O. Amphrisius	6·0
Papilio Macedon (Celebes)	5·8	P. Peranthus	3·8
P. Philippus (Moluccas)	4·8		
P. Blumei (Celebes)	5·4	P. Brama	4·0
P. Alphenor (Celebes)	4·8	P. Theseus	3·6
P. Gigon (Celebes)	5·4	P. Demolion	4·0
P. Deucalion (Celebes)	4·6	P. Macareus	3·7
P. Agamemnon, var. (Celebes)	4·4	P. Agamemnon, var.	3·8
P. Eurypilus (Moluccas)	4·0	P. Jason	3·4
P. Telephus (Celebes)	4·3		
P. Ægisthus (Moluccas)	4·4	P. Rama	3·2
P. Miletus (Celebes)	4·4	P. Sarpedon	3·8
P. Androcles (Celebes)	4·8	P. Antiphates	3·7
P. Polyphontes (Celebes)	4·6	P. Diphilus	3·9
Leptocircus Curtius (Celebes)	2·0	L. Meges	1·8

Species inhabiting Amboyna (large).		Allied species of New Guinea and the North Moluccas (smaller).	
Papilio Ulysses	6·1	P. Penelope	5·2
		P. Telegonus	4·0
P. Polydorus	4·9	P. Leodamas	4·0
P. Deiphobus	6·8	P. Deiphontes	5·8
P. Gambrisius	6·4	P. Ormenus	5·6
		P. Tydeus	6·0
P. Codrus	5·1	P. Codrus, var. *papuensis*	4·3
Ornithoptera Priamus, ♂	8·0	Orn. Poseidon, ♂	7·0

The differences of form are equally clear.

Papilio Pammon everywhere on the continent is tailed in both sexes. In Java, Sumatra, and Borneo, the closely allied *P. Theseus* has a very short tail, or tooth only, in the male, while in the females the tail is retained. Further east, in Celebes and the South Moluccas, the hardly separable *P. Alphenor* has quite lost the tail in the male, while the female retains it, but in a narrower and less spatulate form. A little further, in Gilolo, *P. Nicanor* has completely lost the tail in both sexes.

Papilio Agamemnon exhibits a somewhat similar series of changes. In India it is always tailed; in the greater part of the archipelago it has a very short tail; while far east, in New Guinea and the adjacent islands, the tail has almost entirely disappeared.

In the *Polydorus*-group two species, *P. Antiphus* and *P. Diphilus*, inhabiting India and the Indian region, are tailed, while the two which take their place in the Moluccas, New Guinea, and Australia, *P. Polydorus* and *P. Leodamas*, are destitute of tail, the species furthest east having lost this ornament the most completely.

Western species, tailed.		Eastern species (closely allied), less tailed.	
Papilio Pammon (India)	tailed.	P. Thesus (islands)	very short tail.
P. Agamemnon, var. (India)	tailed.	P. Agamemnon, var. (islands)	not tailed.
P. Antiphus (India, Java)	tailed.	P. Polydorus (Moluccas)	not tailed.
P. Diphilus (India, Java)	tailed.	P. Leodamas (New Guinea)	not tailed.

The most conspicuous instance of local modification of form, however, is exhibited in the island of Celebes, which in this respect, as in some others, stands alone and isolated in the whole archipelago. Almost every species of *Papilio* inhabiting Celebes has the wings of a peculiar shape, which distinguishes them at a glance from the allied species of every other island. This peculiarity consists, first, in the upper wings being generally more elongate and falcate; and secondly, in the costa or anterior margin being much more curved, and in most instances exhibiting near the base an abrupt bend or elbow, which in some species is very conspicuous. This peculiarity is visible, not only when the Celebesian species are compared with their small-sized allies of Java and Borneo, but also, and in an almost equal degree, when the large forms of Amboyna and the Moluccas are the objects of comparison, showing that this is quite a distinct phenomena from the difference of size which has just been pointed out.

In the following Table I have arranged the chief Papilios of Celebes in the order in which they exhibit this characteristic form most prominently. (See Plate VIII.)

Papilios of Celebes, having the wings falcate or with abruptly curved costa.	Closely allied Papilios of the surrounding islands, with less falcate wings and slightly curved costa.
1. P. Gigon, n. s.	P. Demolion (Java).
2. P. Telephus, n. s.	P. Jason (Sumatra).
3. P. Miletus, n. s.	P. Sarpedon (Moluccas, Java).
4. P. Agamemnon, var.	P. Agamemnon, var. (Borneo).
5. P. Macedon, n. s.	P. Peranthus (Java).
6. P. Ascalaphus.	P. Deiphontes, n. s. (Gilolo).
7. P. Hecuba, n. s.	P. Helenus (Java).
8. P. Blumei.	P. Brama (Sumatra).
9. P. Androcles.	P. Antiphates (Borneo).
10. P. Rhesus.	P. Aristæus (Moluccas).
11. P. Theseus, var., ♂.	P. Thesus, ♂ (Java).
12. P. Codrus, var.	P. Codrus (Moluccas).
13. P. Encelades.	P. Leucothoë (Malacca).

It thus appears that every species of *Papilio* exhibits this peculiar form in a greater or less degree, except one, *P. Polyphontes*, Bd., allied to *P. Diphilus* of India and *P. Polydorus* of the Moluccas. This fact I shall recur to again, as I think it helps us to understand something of the causes that may have brought about the phenomenon we are considering. Neither do the genera *Ornithoptera* and *Leptocircus* exhibit any traces of this peculiar form. In several other families of Butterflies this characteristic form reappears in a few species. In the Pieridæ the following species exhibit it distinctly:—

1. Eronia tritæa	compared with	Eronia Valeria (Java).
2. Iphias Glaucippe, var.	„ „	Iphias Glaucippe (Java).
3. Pieris Zebuda	„ „	Pieris Descombesi (India).
4. P. Zarinda	„ „	P. Nero (Malacca).
5. P., n. s.	„ „	P. Hyparete (Java).
6. P. Hombronii	have the same form, but are isolated species.	
7. P. Ithome		
8. P. Eperia, *Bd.*	compared with	P. Coronis (Java).
9. P. Polisma	„ „	P., n. s. (Malacca).
10. Terias, n. s.	„ „	P. Tilaha (Java).

The other species of *Terias*, one or two *Pieris*, and the genus *Callidryas* do not exhibit any perceptible change of form.

In the other families there are but few similar examples. The following are all that I can find in my collection :—

Cethosia Æole	compared with	Cethosia Biblis (Java).
Junonia, n. s.	„ „	Junonia Polynice (Borneo).
Limenitis Limire	„ „	Limenitis Procris (Java).
Cynthia Arsinoë, var.	„ „	Cynthia Arsinoë (Java, Sum., Born.).

All these belong to the family of the Nymphalidæ. Many other genera of this family, as *Diadema*, *Adolias*, *Charaxes*, and *Cyrestis*, as well as the entire families of the Danaidæ, Satyridæ, Lycænidæ, and Hesperidæ, present no examples of this peculiar form of the upper wing in the Celebesian species.

The facts now brought forward seem to me of the highest interest. We see that almost all the species in two important families of the Lepidoptera (Papilionidæ and Pieridæ) acquire, in a single island, a characteristic modification of form distinguishing them from the allied species and varieties of all the surrounding islands. In other equally extensive families no such change occurs, except in one or two isolated species. However we may account for these phenomena, or whether we may be quite unable to account for them, they furnish, in my opinion, a strong corroborative testimony in favour of the doctrine of the origin of species by successive small variations; for we have here slight varieties, local races, and undoubted species, all modified in exactly the same manner, indicating plainly a common cause producing identical results. On the generally received theory of the original distinctness and permanence of species, we are met by this difficulty: one portion of these curiously modified forms are admitted to have been produced by variation and some natural action of local conditions; whilst the other portion, differing from the former only in degree, and connected with them by insensible gradations, are said to have possessed this peculiarity of form at their first creation, or to have derived it from unknown causes of a totally distinct nature. Is not the *à priori* evidence in favour of the assumption of an identity of the causes that have produced such similar results? and have we not a right to call upon our opponents for some proofs of their own doctrine, and for an explanation of its difficulties, instead of their assuming that they are right, and laying upon us the burthen of disproof?

Let us now see if the facts in question do not themselves furnish some clue to their own explanation. Mr. Bates has shown that certain groups of butterflies have a defence against insectivorous animals, independent of swiftness of motion. These are generally very abundant, slow, and weak fliers, and are more or less the objects of mimicry by other groups, which thus gain an advantage in a freedom from persecution similar to that enjoyed by those they resemble. Now the only Papilios which have not in Celebes acquired the peculiar form of wing belong to a group which is imitated both by other species of *Papilio* and by Moths of the genus *Epicopeia,* West. This group is of weak and slow flight; and we may therefore fairly conclude that it possesses some means of defence (probably in a peculiar odour or taste) which saves it from attack. Now the arched costa and falcate form of wing is generally supposed to give increased powers of flight, or, as seems to me more probable, greater facility in making sudden turnings, and thus baffling a pursuer. But the members of the *Polydorus*-group (to which belongs the only unchanged Celebesian *Papilio*), being already guarded against attack, have no need of this increased power of wing; and "natural selection" would therefore have no tendency to produce it. The whole family of Danaidæ are in the same position: they are slow and weak fliers; yet they abound in species and individuals, and are the objects of mimicry. The Satyridæ have also probably a means of protection—perhaps their keeping always near the ground and their generally obscure colours; while the Lycænidæ and Hesperidæ may find security in their small size and rapid motions. In the extensive family of the Nymphalidæ, however, we find that several of the larger species, of comparatively feeble structure, have their wings modified (*Cethosia*, *Limenitis*, *Junonia*, *Cynthia*), while the large-bodied powerful species, which have all an excessively rapid flight, have exactly the same form of wing in Celebes as in the other islands. On the whole, therefore, we may say that all the butterflies of rather large size, conspicuous colours, and not very swift flight have been affected in the manner described, while the smaller-sized and obscure groups, as well as those which are the objects of mimicry, and also those of exceedingly swift flight, have remained unaffected.

It would thus appear as if there must be (or once have been) in the island of Celebes, some peculiar enemy to these larger-sized butterflies which does not exist, or is less abundant, in the surrounding islands. Increased powers of flight, or rapidity of turning, was advantageous in baffling this enemy; and the peculiar form of wing necessary to give this would be readily acquired by the action of "natural selection" on the slight variations of form that are continually occurring. Such an enemy one would naturally suppose to be an insectivorous bird; but it is a remarkable fact that most of the genera of Fly-catchers of Borneo and Java on the one side (*Muscipeta*, *Philentoma*), and of the Moluccas on the other (*Monarcha*, *Rhipidura*), are almost entirely absent from Celebes. Their place seems to be supplied by the Caterpillar-catchers (*Graucalus*, *Campephaga*), of which six or seven species are known from Celebes and are very numerous in individuals. We have no positive evidence that these birds pursue butterflies on the wing, but it is highly probable that they do so when other food is scarce*. However this may be, the fauna of Celebes is undoubtedly highly peculiar in every department of which we have any knowledge; and though we may not be able to trace it satisfactorily, there can, I think, be little doubt that the singular modification in the wings of so many of the butterflies of that island is an effect of that complicated action and reaction of all living things upon each other in the struggle for existence, which continually tends to readjust disturbed relations, and to bring every species into harmony with the varying conditions of the surrounding universe.

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* Mr. Bates has suggested that the larger Dragon-flies (*Æshna*, &c.) prey upon butterflies; but I did not notice that they were more abundant in Celebes than elsewhere.

But even the conjectural explanation now given fails us in the other cases of local modification. Why the species of the western islands should be smaller than those further east, —why those of Amboyna should exceed in size those of Gilolo and New Guinea—why the tailed species of India should begin to lose that appendage in the islands, and retain no trace of it on the borders of the Pacific, are questions which we cannot at present attempt to answer. That they depend, however, on some general principle is certain, because analogous facts have been observed in other parts of the world. Mr. Bates informs me that, in three distinct groups, Papilios which on the Upper Amazon and in most other parts of South America have spotless upper wings obtain pale or white spots at Pará and on the Lower Amazon; and also that the *Æneas*-group of Papilios never have tails in the equatorial regions and the Amazons valley, but gradually acquire tails in many cases as they range towards the northern or southern tropic. Even in Europe we have somewhat similar facts; for the species and varieties of butterflies peculiar to the island of Sardinia are generally smaller and more deeply coloured than those of the mainland, and *Papilio Hospiton* has lost the tail, which is a prominent feature of the closely allied *P. Machaon*.

Facts of a similar nature to those now brought forward would no doubt be found to occur in other groups of insects, were local faunas carefully studied in relation to those of the surrounding countries; and they seem to indicate that climate and other physical causes have, in some cases, a very powerful effect in modifying specific form, and thus directly aid in producing the endless variety of nature.

I may state that I can adduce facts perfectly analogous to these from other families of Lepidoptera, especially the Danaidæ; but as the greater part of the species are still undescribed, I can only now assert that similar phenomena do occur there.

Mimicry.

I need scarcely say that I entirely agree with Mr. Bates's explanation of the causes which have led to one group of insects mimicking another (Trans. Linn. Soc. vol. xxiii. p. 495). I have, therefore, only now to adduce such illustrations of this curious phenomenon as are furnished by the Eastern Papilionidæ, and to show their bearing upon the phenomena of variation already mentioned. As in America, so in the Old World, species of Danaidæ are the objects which the other families most often imitate. But, besides these, some genera of Morphidæ and one section of the genus *Papilio* are also less frequently copied. Many species of *Papilio* mimic other species of these three groups so closely that they are undistinguishable when on the wing; and in every case the pairs which resemble each other inhabit the same locality.

The following list exhibits the most important and best-marked cases of mimicry which occur among the Papilionidæ of the Malayan region and India:—

Mimickers*.	Species mimicked.	Common habitat.
	DANAIDÆ.	
1. Papilio paradoxa, *Zink.*, ♂	Euplœa Midamus, *Cr.*, ♂	Sumatra, &c.
—— ——, ♀	—— ——, ♀	
2. —— ——, *West.*	E. Rhadamanthus	Sumatra, &c.
3. P. Caunus,	E., sp.	Borneo.
4. P. Thule, *Wall.*	Danais sobrina, *Bd.*	New Guinea.
5. P. Macareus, *Godt.*	D. Aglaia, *Cr.*	Malacca, Java.
6. P. Agestor, *G. R. G.*	D. Tytia, *G. R. G.*	Northern India.
7. P. idæoides, *Hewits.*	Hestia Leuconoë, *Erichs.*	Philippines.
8. P. Delessertii, *Guér.*	Hestia, sp.	Penang.
	MORPHIDÆ.	
9. P. Pandion, *Wall.*, ♀	Drusilla bioculata, *Guér.*	New Guinea.
	PAPILIO (POLYDORUS- and COON-groups).	
10. P. Pammon, *L.* (Romulus, *L.*), ♀	Papilio Hector, *L.*	India.
11. P. Theseus, *Cr.*, var., ♀	P. Antiphus, *Fab.*	Sumatra, Borneo.
12. P. Theseus, *Cr.*, var., ♀	P. Diphilus, *Esp.*	Sumatra, Java.
13. P. Memnon, var. *Achates*, ♀	P. Coon, *Fab.*	Sumatra.
14. P. Androgeus, var. *Achates*, ♀	P. Doubledayi, *Wall.*	Northern India.
15. P. Œnomaus, *God.*, ♀	P. Liris, *God.*	Timor.

We have therefore fifteen species or marked varieties of *Papilio* which so closely resemble species of other groups in their respective localities, that it is not possible to impute the resemblance to accident. The first two in the list (*Papilio paradoxa* and *P. Caunus*) are so exactly like *Euplœa Midamus* and *E. Rhadamanthus* on the wing, that, although they fly very slowly, I was quite unable to distinguish them. The first is a very interesting case, because the male and female differ considerably, and each mimics the corresponding sex of the *Euplœa*. A new species of *Papilio* which I discovered in New Guinea resembles *Danais sobrina*, Bd., from the same country, just as *Papilio Macareus* resembles *Danais Aglaia* in Malacca, and (according to Dr. Horsfield's figure) still more closely in Java. The Indian *Papilio Agestor* closely imitates *Danais Tytia*, which has quite a different style of colouring from the preceding; and the extraordinary *Papilio idæoides* from the Philippine Islands must, when on the wing, perfectly resemble the *Hestia Leuconoë* of the same region, as also does the *P. Delessertii*, Guér., imitate an undescribed species of *Hestia* from Penang. Now in every one of these cases the Papilios are very scarce, while the Danaidæ which they resemble are exceedingly abundant—most of them swarming so as to be a positive nuisance to the collecting entomologist by continually hovering before him when he is in search of newer and more varied captures. Every garden, every roadside, the suburbs of every village are full of them, indicating very clearly that their life is an easy one, and that they are free from persecution by the foes which keep down the population of less favoured races. This superabundant population has been shown by Mr. Bates to be a general characteristic of all American groups and species which are objects of mimicry; and it is interesting to find his observations confirmed by examples on the other side of the globe.

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* The terms "*mimicry*" and "*mimickers*" have been objected to on the ground that they imply *voluntary action* on the part of the insects. This appears to me of little importance compared with the advantages of convenience, flexibility, and expressiveness which they undoubtedly possess, especially as the whole theory propounded by the originator of the term in this sense excludes all idea of voluntary action. The only approximately synonymous words, not implying will, are *resemblance*, *similarity*, and *likeness*; and it is evident that none of these can be applied intelligibly under the variety of forms required, and to which Mr. Bates's expression so readily lends itself in the terms *mimic*, *mimickers*, *mimicry*, *mimicked*. Add to this the inconvenience of changing a term which, from the interest and wide discussion of the subject, must be already very generally understood, and I think it will be admitted that nothing would be gained by altering it, even if a better word were pointed out, which has not yet been done.

The remarkable genus *Drusilla*, a group of pale-coloured butterflies, more or less adorned with ocellate spots, is also the object of mimicry by three distinct genera (*Melanitis*, *Hyantis*, and *Papilio*). These insects, like the *Danaidæ*, are abundant in individuals, have a very weak and slow flight, and do not seek concealment, or appear to have any means of protection from insectivorous creatures. It is natural to conclude, therefore, that they have some hidden property which saves them from attack; and it is easy to see that when any other insects, by what we call accidental variation, come more or less remotely to resemble them, the latter will share to some extent in their immunity. An extraordinary dimorphic form of a female *Papilio* has come to resemble the Drusillas sufficiently to be taken for one of that group at a little distance; and it is curious that I captured one of these Papilios in the Aru Islands hovering along the ground, and settling on it occasionally, just as it is the habit of the Drusillas to do. The resemblance in this case is only general; but this form of *Papilio* varies much, and there is therefore material for natural selection to act upon so as ultimately to produce a copy as exact as in the other cases.

The eastern Papilios allied to *Polydorus Coon* and *P. Philoxenus*, form a natural section of the genus resembling, in many respects, the *Æneas*-group of South America, which they may be said to represent in the East. Like them, they are forest insects, have a low and weak flight, and in their favourite localities are rather abundant in individuals; and like them, too, they are the objects of mimicry. We may conclude, therefore, that they possess some hidden means of protection, which makes it useful to other insects to be mistaken for them.

The Papilios which resemble them belong to a very distinct section of the genus, in which the sexes differ greatly; and it is those females only which differ most from the males, and which have already been alluded to as exhibiting instances of dimorphism, which resemble species of the other group.

The resemblance of *P. Romulus* to *P. Hector* is, in some specimens, very considerable, and has led to the two species being placed to follow each other in the British Museum Catalogues and by Mr. E. Doubleday. I have shown, however, that *P. Romulus* is probably a dimorphic form of the female *P. Pammon*, and belongs to a distinct section of the genus*.

The next pair, *P. Theseus*, Cr., and *P. Antiphus*, Fab., have been united as one species both by De Haan and in the British Museum Catalogues. The ordinary variety of *P. Theseus* found in Java almost as nearly resembles *P. Diphilus*, Esp., of the same country. The most interesting case, however, is the extreme female form of *P. Memnon* (*P. Achates*, Cr.)†, which has acquired the general form and markings of *P. Coon*, an insect which differs from the ordinary male *P. Memnon*, as much as any two species differ which can be chosen in this extensive and highly varied genus; and, as if to show that this resemblance is not accidental, but is the result of law, when in India we find a species closely allied to

* See Plate II. fig. 6.

† See Plate I. fig. 4.

P. Coon, but with red instead of yellow spots (*P. Doubledayi*, Wall.), the corresponding variety of *P. Androgeus* (*P. Achates*, Cram., 182, A, B,) has acquired exactly the same peculiarity of having red spots instead of yellow. Lastly, in the island of Timor, the female of *P. Œnomaus* (a species allied to *P. Memnon*) resembles so closely *P. Liris* (one of the *Polydorus*-group), that the two, which were often seen flying together, could only be distinguished by a minute comparison after being captured.

The last six cases of mimicry are especially instructive, because they seem to indicate one of the processes by which dimorphic forms have been produced. When, as in these cases, one sex differs much from the other, and varies greatly itself, it may happen that occasionally individual variations will occur having a distant resemblance to groups which are the objects of mimicry, and which it is therefore advantageous to resemble. Such a variety will have a better chance of preservation; the individuals possessing it will be multiplied; and their accidental likeness to the favoured group will be rendered permanent by hereditary transmission, and, each successive variation which increases the resemblance being preserved, and all variations departing from the favoured type having less chance of preservation, there will in time result those singular cases of two or more isolated and fixed forms bound together by that intimate relationship which constitutes them the sexes of a single species. The reason why the females are more subject to this kind of modification than the males is, probably, that their slower flight, when laden with eggs, and their exposure to attack while in the act of depositing their eggs upon leaves, render it especially advantageous for them to have some additional protection. This they at once obtain by acquiring a resemblance to other species which, from whatever cause, enjoy a comparative immunity from persecution.

This summary of the more interesting phenomena of variation presented by the eastern Papilionidæ is, I think, sufficient to substantiate my position, that the Lepidoptera are a group that offer especial facilities for such inquiries; and it will also show that they have undergone an amount of special adaptive modification rarely equalled among the the more highly organized animals. And, among the Lepidoptera, the great and pre-eminently tropical families of Papilionidæ and Danaidæ seem to be those in which complicated adaptations to the surrounding organic and inorganic universe have been most completely developed, offering in this respect a striking analogy to the equally extraordinary, though totally different, adaptations which present themselves in the *Orchideæ*, the only family of plants in which mimicry of other organisms appears to play any important part, and the only one in which striking cases of polymorphism occur; for such we must consider to be the male, female, and hermaphrodite forms of *Catasetum tridentatum*, which differ so greatly in form and structure that they were long considered to belong to three distinct genera.

Arrangement and Geographical Distribution of the Malayan Papilionidæ.

Although the species of Papilionidæ inhabiting the Malayan region are very numerous, they all belong to three out of the nine genera into which the family is divided. One of the remaining genera (*Eurycus*) is restricted to Australia, and another (*Teinopalpus*) to the Himalayan Mountains, while no less than four (*Parnassius*, *Doritis*, *Thais*, and *Sericinus*) are confined to Southern Europe and to the mountain-ranges of the Palæarctic region.

The genera *Ornithoptera* and *Leptocircus* are highly characteristic of Malayan entomology, but are uniform in character and of small extent. The genus *Papilio*, on the other hand, presents a great variety of forms, and is so richly represented in the Malay islands, that more than one-fourth of all the known species are found there. It becomes necessary, therefore, to divide this genus into natural groups before we can successfully study its geographical distribution.

Owing principally to Dr. Horsfield's observations in Java, we are acquainted with a considerable number of the larvæ of Papilios; and these furnish good characters for the primary division of the genus into natural groups. The manner in which the hinder wings are plaited or folded back at the abdominal margin, the size of the anal valves, the structure of the antennæ, and the form of the wings are also of much service, as well as the character of the flight and the style of coloration. Using these characters, I divide the Malayan Papilios into four sections, and seventeen groups, as follows:—

Genus ORNITHOPTERA.

a. *Priamus*-group. Black and green. b. *Pompeus*-group. Black and yellow.
c. *Brookeanus*-group.

Genus PAPILIO.

A. Larvæ short, thick, with numerous fleshy tubercles; purplish.
  a. *Nox*-group. Abdominal fold in ♂ very large; anal valves small, but swollen; antennæ moderate; wings entire, or tailed: includes the Indian *Philoxenus*-group.
  b. *Coon*-group. Abdominal fold in ♂ small; anal valves small, but swollen; antennæ moderate; wings tailed.
  c. *Polydorus*-group. Abdominal fold in ♂ small, or none; anal valves small or obsolete, hairy; wings tailed or entire.
B. Larvæ with third segment swollen, transversely or obliquely banded; pupa much bent. Imago with abdominal margin in ♂ plaited, but not reflexed; body weak; antennæ long; wings much dilated, often tailed. d. *Ulysses*-group.
  e. *Peranthus*-group. } *Protenor*-group (Indian) is somewhat intermediate between these, and is
  f. *Memnon*-group. } nearest to the *Nox*-group.
  g. *Helenus*-group. h. *Erectheus*-group.
  i. *Pammon*-group. k. *Demolion*-group.
C. Larvæ subcylindrical, variously coloured. Imago with abdominal margin in ♂ plaited, but not reflexed; body weak; antennæ short, with a thick curved club; wings entire.
  l. *Erithonius*-group. Sexes alike, larva and pupa something like those of *P. Demolion*.
  m. *Paradoxa*-group. Sexes different.
  n. *Dissimilis*-group. Sexes alike; larva bright-coloured; pupa straight, cylindric.
D. Larvæ elongate, attenuate behind, and often bifid, with lateral and oblique pale stripes, green. Imago with the abdominal margin in ♂ reflexed, woolly or hairy within; anal valves small, hairy; antennæ short, stout; body stout.
  o. *Macareus*-group. Hind wings entire.
  p. *Antiphates*-group. Hind wings much tailed (swallow-tails).
  q. *Eurypylus*-group. Hind wings elongate or tailed.

Genus LEPTOCIRCUS.

making, in all, twenty distinct groups of Malayan Papilionidæ.

The first section of the genus *Papilio* (A) comprises insects which, though differing considerably in structure, have much general resemblance. They all have a weak, low flight, frequent the most luxuriant forest-districts, seem to love the shade, and are the objects of mimicry by other Papilios.

Section B consists of weak-bodied, large-winged insects, with an irregular wavering flight, and which, when resting on foliage, often expand the wings, which the species of the other sections rarely or never do. They are the most conspicuous and striking of of eastern Butterflies.

Section C consists of much weaker and slower-flying insects, often resembling in their flight, as well as in their colours, species of Danaidæ.

Section D contains the strongest-bodied and most swift-flying of the genus. They love sunlight, and frequent the borders of streams and the edges of puddles, where they gather together in swarms consisting of several species, greedily sucking up the moisture, and, when disturbed, circling round in the air, or flying high and with great strength and rapidity.

In the following Table I have arranged all the Malayan Papilionidæ in what appears to me their most natural succession, and have exhibited their distribution in twenty-one columns of localities, extending from the Malay peninsula, on the north-west, to Woodlark Island, near New Guinea, on the south-east. The double line divides the Indo-Malayan from the Austro-Malayan region; and those islands which form natural zoological groups are connected by brackets.

Table showing the Distribution of the Malayan Papilionidæ.

		INDO-MALAYAN REGION.					AUSTRO-MALAYAN REGION.															
	Ornithoptera.	Malacca.	Sumatra.	Borneo.	Java.	Philippines.	Celebes.	Lombock.	Timor.	Gilolo.	Batchian.	Bouru.	Ceram.	Banda.	Goram.	Kē Islands.	Aru Islands.	Mysol.	Waigiou.	New Guinea.	New Ireland.	Woodlark Isl.
	a. *Priamus*-group.																					
1	Priamus, *L.*	..	..	..	..	..	..	..	..	..	..	..	1									
2	Poseidon, *Db.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	1	..	1
3	Crœsus, *Feld.*	..	..	..	..	..	..	..	..	1	1											
4	Tithonus, *De Haan*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1		
5	Urvilliana, *Guér.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	
	b. *Pompeus*-group.																					
6	Remus, *Cr.*	..	..	..	..	..	1	..	..	1	..	..	1									
7	Helena, *L.*	..	..	..	..	..	1	..	..	..	..	1	1	..	..	..	..	..	..	1*v*		
8	Leda, *Wall.*	..	..	..	..	..	1															
9	Pompeus, *Cr.*	1	1	1	1	..	..	1														
10	Nephereus, *G.R.G.*	..	..	..	..	1																
11	Magellanus, *Feld.*	..	..	..	..	1																
12	Criton, *Feld.*	..	..	..	..	..	..	..	..	1	1											
13	Plato, *Wall.*	..	..	..	..	..	..	..	1													
14	Haliphron, *Bd.*	..	..	..	..	..	1															
15	Amphrisius, *Cr.*	1	..	1	1																	
	c. *Brookeana*-group.																					
16	Brookeana, *Wall.*	..	1	1																		
	Papilio.																					
A.	a. *Nox*-group.																					
17	Nox, *Sw.*	1	..	..	1																	
18	Noctis, *Hew.*	..	..	1																		
19	Erebus, *Wall.*	1	..	1																		

Table showing the Distribution of the Malayan Papilionidæ (*continued*).

	Papilio.	Indo-Malayan Region.					Austro-Malayan Region.															
		Malacca.	Sumatra.	Borneo.	Java.	Philippines.	Celebes.	Lombock.	Timor.	Gilolo.	Batchian.	Bouru.	Ceram.	Banda.	Goram.	Kè Island.	Aru Islands.	Mysol.	Waigiou.	New Guinea.	New Ireland.	Woodlark Isl.
	a. *Nox*-group (*continued*).																					
20	Varuna, *White*	1																				
21	Semperi, *Feld.*	..	..	..	..	1																
	b. *Coon*-group.																					
22	Neptunus, *Guér.*	1	..	1																		
23	Coon, *Fab.*	..	1	1	1																	
	c. *Polydorus*-group.																					
24	Polydorus, *L.*	..	..	..	..	..	..	..	..	..	1	1	1	..	..	1	1					
25	Leodamas, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1		
26	Diphilus, *Esper*	1	..	..	1	1																
27	Antiphus, *Fab.*	..	1	1	1	1	..	1														
28	Polyphontes, *Bd.*	..	..	..	..	..	1	..	..	1	1											
29	Annæ, *Feld.*	..	..	..	..	1																
30	Liris, *Godt.*	..	..	..	..	..	..	..	1													
B.	d. *Ulysses*-group.																					
31	Ulysses, *L.*	..	..	..	..	..	..	..	..	..	..	..	1									
32	Penelope, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	1		
33	Telegonus, *Feld.*	..	..	..	..	..	..	..	..	1	1											
34	Telemachus, *Mont.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	e. *Peranthus*-group.																					
35	Peranthus, *Fab.*	..	..	..	1	..	..	1														
36	Pericles, *Wall.*	..	..	..	..	..	..	..	1													
37	Philippus, *Wall.*	..	..	..	..	..	..	..	..	..	1	..	1									
38	Macedon, *Wall.*	..	..	..	..	..	1															
39	Brama, *Guér.*	1	1																			
40	Dædalus, *Feld.*	..	..	..	..	1																
41	Blumei, *Bd.*	..	..	..	..	..	1															
42	Arjuna, *Horsf.*	..	1	1	1																	
	f. *Memnon*-group.																					
43	Memnon, *L.*	..	1	1	1	..	..	1														
44	Androgeus, *Cr.*	1																				
45	Lampsacus, *Bd.*	..	..	..	1																	
46	Priapus, *Bd.*	..	1	1	1																	
47	Emalthion, *Hübn.*	..	..	..	..	1																
48	Deiphontes, *Wall.*	..	..	..	..	..	..	..	..	1	1											
49	Deiphobus, *L.*	..	..	..	..	..	..	..	..	..	..	1	1									
50	Ascalaphus, *Bd.*	..	..	..	..	..	1															
51	Ænomaus, *Godt.*	..	..	..	..	..	..	..	1													
	g. *Helenus*-group.																					
52	Severus, *Cr.*	..	..	..	..	..	..	..	..	1	1	1	1	..	..	..	1					
53	Pertinax, *Wall.*	..	..	..	..	..	1															
54	Albinus, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1		
55	Phæstus, *Bd.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1		
56	Helenus, *L.*	..	1	..	1																	
57	Hecuba, *Wall.*	..	..	..	..	..	1															
58	Iswara, *White*	1	..	1																		
59	Hystaspes, *Feld.*	..	..	..	..	1																
60	Araspes, *Feld.*	..	..	..	..	1																
61	Nephelus, *Bd.*	1	1	1																		
	h. *Pammon*-group.																					
62	Pammon, *L.*	1																				
63	Theseus, *Cr.*	..	1	1	1	..	..	1	1													

Table showing the Distribution of the Malayan Papilionidæ (*continued*).

	Papilio.	Indo-Malayan Region.					Austro-Malayan Region.															
	h. *Pammon*-group (*continued*).	Malacca.	Sumatra.	Borneo.	Java.	Philippines.	Celebes.	Lombock.	Timor.	Gilolo.	Batchian.	Bouru.	Ceram.	Banda.	Goram.	Ké Island.	Aru Islands.	Mysol.	Waigiou.	New Guinea.	New Ireland.	Woodlark Isl.
64	Alphenor, *Cr.*	..	..	..	..	1	1	..	..	..	..	1	1									
65	Nicanor, *Wall.*	..	..	..	..	..	..	..	..	1	1											
66	Hipponous, *Feld.*	..	..	..	..	1																
67	Ambrax, *Bd.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1		
68	Ambracia, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1			
69	Epirus, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1					
70	Dunali, *Montr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	i. *Erectheus*-group.																					
71	Ormenus, *Guér.*	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	..	1			
72	Pandion, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1		
73	Tydeus, *Feld.*	..	..	..	..	..	..	..	..	1	1											
74	Adrastus, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	1								
75	Gambrisius, *Cr.*	..	..	..	..	..	..	..	..	..	..	1	1									
76	Amphytrion, *Cr.*	..	..	..	..	..	1															
77	Euchenor, *Guér.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	1	1		
78	Godartii, *Montr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	k. *Demolion*-group.																					
79	Demolion, *Cr.*	1	1	1	1																	
80	Gigon, *Wall.*	..	..	..	..	..	1															
	l. *Erithonius*-group.																					
81	Erithonius, *Cr.*	1	..	..	..	1	..	..	1	..	..	..	..	..	..	1						
	m. *Paradoxa*-group.																					
82	Paradoxa, *Zink.*	..	1	1	1																	
83	Ænigma, *Wall.*	1	1	1																		
84	Caunus, *Westw.*	..	1	1																		
85	Astina, *Westw.*	..	..	..	1																	
86	Hewitsonii, *Westw.*	..	..	1																		
	n. *Dissimilis*-group.																					
87	Echidna, *De Haan.*	..	..	..	..	..	..	..	1													
88	Paëphates, *Westw.*	..	..	..	..	1																
	o. *Macareus*-group.																					
89	Veiovis, *Hew.*	..	..	..	..	..	1															
90	Encelades, *Bd.*	..	..	..	..	..	1															
91	Deucalion, *Bd.*	..	..	..	..	..	1															
92	Idæoides, *Hew.*	..	..	..	..	1																
93	Delessertii, *Guér.*	1																				
94	Dehaanii, *Wall.*	1	..	1	1																	
95	Leucothoë, *Westw.*	1																				
96	Macareus, *Godt.*	1	..	1	1																	
97	Stratocles, *Feld.*	..	..	..	..	1																
98	Thule, *Wall.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1		
	p. *Antiphates*-group.																					
99	Antiphates, *Cr.*	1	1	1	1																	
100	Euphrates, *Feld.*	..	..	..	..	1′																
101	Androcles, *Bd.*	..	..	..	..	..	1															
102	Dorcus, *De Haan.*	..	..	..	..	..	1															
103	Rhesus, *Bd.*	..	..	..	..	..	1															
104	Aristæus, *Cr.*	..	..	..	..	..	..	..	..	..	1	..	1									
105	Parmatus, *G. R. G.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	.	1			

Table showing the Distribution of the Malayan Papilionidæ (*continued*).

		Indo-Malayan Region.					Austro-Malayan Region.															
	Papilio (*continued*).	Malacca.	Sumatra.	Borneo.	Java.	Philippines.	Celebes.	Lombock.	Timor.	Gilolo.	Batchian.	Bouru.	Ceram.	Banda.	Goram.	Ké Island.	Aru Islands.	Mysol.	Waigiou.	New Guinea.	New Ireland.	Woodlark Isl.
	q. *Eurypylus*-group.																					
106	Codrus, *Cr.*	..	..	..	..	..	1	..	..	1	1	1	1	..	..	..	1	..	1			
107	Melanthus, *Feld.*	..	..	..	..	1																
108	Empedocles, *Fab.*	..	..	1	1	..																
109	Payeni, *Bd.*	..	..	1	1																	
110	Sarpedon, *L.*	1	1	1	1	..	..	..	..	1	1	1	1	..	..	..	1	..	..	1		
111	Miletus, *Wall.*	..	..	..	..	..	1															
112	Wallacei, *Hew.*	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1					
113	Bathycles, *Zink.*	1	..	1	1																	
114	Eurypylus, *L.*	..	..	..	..	..	..	..	..	1	1	1	1	..	..	..	..	..	..	1		
115	Jason, *Esp.*	1	1	1	1																	
116	Telephus, *Wall.*	..	..	..	..	..	1															
117	Ægistus, *L.*	..	..	..	..	..	..	..	..	1	1	..	1	..	..	1	1					
118	Agamemnon, *L.*	1	1	1	1	1	1	1	1	1	1	1	1	..	..	1	1	1	1	1		
119	Rama, *Feld.* (? Arycles, *Bd.*)	1	1																			
	Leptocircus.																					
120	Meges, *Zink.*	1	..	..	1																	
121	Curtius, *Wall.*	..	..	..	..	..	1															
122	Decius, *Feld.*	..	..	..	..	1																
123	Curius, *Fab.*	..	..	..	1																	
	Totals :—																					
	Ornithoptera	2	2	3	2	2	4	1	1	3	2	1	3	..	1	1	1	1	1	3	1	1
	Papilio	22	19	26	23	17	19	5	7	11	15	9	13	1	2	4	12	4	8	11	..	4
	Leptocircus	1	..	..	2	1	1															
	Species in each island	25	21	29	27	20	24	6	8	14	17	10	16	1	3	5	13	5	9	14	1	5
	Total	45				20	24	12		27							27					
		Sixty-one, Indo-Malayan Region.					Seventy-two, Austro-Malayan Region.															

The exceeding richness of the Malayan region in these fine insects is seen by comparing the number of species found in the different tropical regions of the earth. From all Africa only 33 species of *Papilio* are known; but as several are still undescribed in collections, we may raise their number to about 40. In all tropical Asia there are at present described only 65 species, and I have seen in collections but two or three which have not yet been named. In South America, south of Panama, there are 120 species, or about the same number as I make in the Malayan region; but the area of the two countries is very different; for while South America (even excluding Patagonia) contains 5,000,000 square miles, a line encircling the whole of the Malayan islands would only include an area of 2,700,000 square miles, of which the land-area would be about 1,000,000 square miles. This superior richness is partly real and partly apparent. The breaking up of a district into small isolated portions, as in an archipelago, seems highly favourable to the segregation and perpetuation of local peculiarities in certain groups; so that a species which on a continent might have a wide range, and whose local forms, if any, would be so connected together that it would be impossible to separate them, may become by isolation reduced to a number of such clearly defined and constant forms that we are obliged to count them as species. From this point of view, therefore, the superior number of Malayan species may be considered as apparent only. Its true superiority is shown, on the other hand, by the possession of three genera and twenty groups of Papilionidæ against a single genus and eight groups in South America, and also by the much greater average size of the Malayan species. In most other families, however, the reverse is the case, the South American *Nymphalidæ*, *Satyridæ*, and *Erycinidæ* far surpassing those of the East in number, variety, and beauty.

The following list, exhibiting the range and distribution of each group, will enable us to study more easily their internal and external relations.

Range of the Groups of Malayan Papilionidæ.

Ornithoptera.

1. *Priamus*-group. Moluccas to Woodlark Island.
2. *Pompeus*-group. Himalayas to New Guinea (Celebes, maximum).
3. *Brookeana*-group. Sumatra and Borneo.

Papilio.

4. *Nox*-group. North India, Java, and Philippines.
5. *Coon*-group. North India to Java.
6. *Polydorus*-group. India to New Guinea and Pacific.
7. *Ulysses*-group. Celebes to New Caledonia.
8. *Peranthus*-group. India to Timor and Moluccas (India, max.).
9. *Memnon*-group. India to Timor and Moluccas (Java, max.).
10. *Helenus*-group. Africa and India to New Guinea.
11. *Pammon*-group. India to Pacific and Australia.
12. *Erechtheus*-group. Celebes to Australia.
13. *Demolion*-group. India to Celebes.
14. *Erithonius*-group. Africa, India, Australia.
15. *Paradoxa*-group. India to Java (Borneo, max.).
16. *Dissimilis*-group. India to Timor (India, max.).
17. *Macareus*-group. India to New Guinea.
18. *Antiphates*-group. Widely distributed.
19. *Eurypylus*-group. India to Australia.

Leptocircus.

20. *Leptocircus*-group. India to Celebes.

This Table shows the great affinity of the Malayan with the Indian Papilionidæ, only three out of the nineteen groups ranging beyond, into Africa, Europe, or America. The limitation of groups to the Indo-Malayan or Austro-Malayan divisions of the archipelago, which is so well marked in the higher animals (see 'Journal of Linnean Society,' vol. iv. 172, and 'Journal of the Royal Geographical Society,' 1863, p. 230), is much less conspicuous in insects, but is shown in some degree by the Papilionidæ. The following groups are either almost or entirely restricted to one portion of the Archipelago:—

Indo-Malayan Region.	*Austro-Malayan Region.*
Nox-group.	*Priamus*-group.
Coon-group.	*Ulysses*-group.
Macareus-group (nearly).	*Erechtheus*-group.
Paradoxa-group.	
Dissimilis-group (nearly).	
Brookeanus-group.	
LEPTOCIRCUS (genus).	

The remaining groups, which range over the whole archipelago, are, in many cases, insects of very powerful flight, or they frequent open places and the sea-beach, and are thus more likely to get blown from island to island. The fact that three such characteristic groups as those of *Priamus*, *Ulysses*, and *Erechtheus* are strictly limited to the Australian region of the archipelago, while five other groups are with equal strictness confined to the Indian region, is a strong corroboration of that division which has been founded almost entirely on the distribution of Mammalia and Birds.

If the various Malayan islands have undergone recent changes of level, and if any of them have been more closely united within the period of existing species than they are now, we may expect to find indications of such changes in community of species between islands now widely separated; while those islands which have long remained isolated would have had time to acquire peculiar forms by a slow and natural process of modification.

An examination of the relations of the species of the adjacent islands will thus enable us to correct opinions formed from a mere consideration of their relative positions. For example, looking at a map of the archipelago, it is almost impossible to avoid the idea that Java and Sumatra have been recently united; their present proximity is so great, and they have such an obvious resemblance in their volcanic structure. Yet there can be little doubt that this opinion is erroneous, and that Sumatra has had a more recent and more intimate connexion with Borneo than it has had with Java. This is strikingly shown by the mammals of these islands—very few of the species of Java and Sumatra being identical, while a considerable number are common to Sumatra and Borneo. The birds show a somewhat similar relationship; and we shall find that the group of insects we are now treating of tells exactly the same tale. Thus:—

Sumatra	21 sp.	20 sp. common to both islands;
Borneo	29 sp.	
Sumatra	21 sp.	11 sp. common to both islands;
Java	27 sp.	
Borneo	29 sp.	20 sp. common to both islands;
Java	27 sp.	

showing that both Sumatra and Java have a much closer relationship to Borneo than they have each other—a most singular and interesting result when we consider the wide separation of Borneo from them both, and its very different structure. The evidence furnished by a single group of insects would have had but little weight on a point of such magnitude if standing alone; but coming as it does to confirm deductions drawn from whole classes of the higher animals, it must be admitted to have considerable value.

We may determine in a similar manner the relations of the different Papuan Islands to New Guinea. Of thirteen species of Papilionidæ obtained in the Aru Islands, five were also found in New Guinea, and eight not. Of nine species obtained at Waigiou, five were New Guinea, and four not. The five species found at Mysol were all New Guinea species. Mysol, therefore, has closer relations to New Guinea than the other islands; and this is corroborated by the distribution of the birds, of which I will only now give one instance. The Paradise Bird found in Mysol is the common New Guinea species, while the Aru Islands and Waigiou have each a species peculiar to themselves.

The large island of Borneo, which contains more species of Papilionidæ than any other in the archipelago, has nevertheless only two peculiar to itself; and it is quite possible, and even probable, that one of these may be found in Sumatra or Java. The last-named island has also two species peculiar to it; Sumatra has not one, and the peninsula of Malacca only one. The identity of species is even greater than in birds or in most other groups of insects, and points very strongly to a recent connexion of the whole with each other and the continent. But when we pass to the next island (Celebes), separated from them by a strait not wider than that which divides them from each other, we have a striking contrast; for with a total number of species less than either Borneo or Java, no less than eighteen are absolutely restricted to it. Further east, the large islands of Ceram and New Guinea have only three species peculiar to each, and Timor has five. We shall have to look, not to single islands, but to whole groups, in order to obtain an amount of individuality comparable with that of Celebes. For example, the extensive group comprising the large islands of Java, Borneo, and Sumatra, with the peninsula of Malacca, possessing altogether 45 species, has about 21, or less than half, peculiar to it; the numerous group of the Philippines possess 21 species, of which 16 are peculiar; the seven chief islands of the Moluccas have 27, of which 12 are peculiar; and the whole of the Papuan Islands, with an equal number of species, have 17 peculiar. Comparable with the most isolated of these groups is Celebes, with its 24 species, of which the large proportion of 18 are peculiar. We see, therefore, that the opinion I have already expressed, in the papers before quoted, of the high degree of isolation and the remarkable distinctive features of this interesting island, is fully borne out by the examination of this conspicuous family of insects. A single straggling island, with a few small satellites, it is zoologically of equal importance with extensive groups of islands many times as large as itself; and standing in the very centre of the archipelago, surrounded on every side with islets connecting it with the larger groups, and which seem to afford the greatest facilities for the migration and intercommunication of their respective productions, it yet stands out conspicuous with a character of its own in every department of nature, and presents peculiarities which are, I believe, without a parallel in any similar locality on the globe.

Briefly to summarize these peculiarities, Celebes possesses three genera of mammals (out of the very small number which inhabit it) which are of singular and isolated forms, viz., *Cynopithecus*, a tailless Ape allied to the Baboons; *Anoa*, a straight-horned

Antelope of obscure affinities, but quite unlike anything else in the whole archipelago or in India; and *Babirusa*, an altogether abnormal wild Pig. With a rather limited bird population, Celebes has an immense preponderance of species confined to it, and has also five remarkable genera (*Meropogon*, *Streptocitta*, *Enodes*, *Scissirostrum*, and *Megacephalon*) entirely restricted to its narrow limits, as well as two others (*Prioniturus* and *Basilornis*) which only range to a single island beyond it.

Mr. Smith's elaborate tables of the distribution of Malayan Hymenoptera (see 'Proc. Linn. Soc.' Zool. vol. vii.) show that, out of the large number of 301 species collected in Celebes, 190 (or nearly two-thirds) were absolutely restricted to it, although Borneo, on one side, and the various islands of the Moluccas on the other, were equally well explored by me; and no less than twelve of the genera are not found in any other island of the archipelago. I have just shown in the present paper that, in the Papilionidæ, it has far more species of its own than any other island, and a greater proportion of peculiar species than many of the large groups of islands in the archipelago—and that it gives to a large number of the species and varieties which inhabit it, 1st, an increase of size, and, 2nd, a peculiar modification in the form of the wings, which stamp upon the most dissimilar insects a mark distinctive of their common birth-place.

What, I would ask, are we to do with phenomena such as these? Are we to rest content with that very simple, but at the same time very unsatisfying explanation, that all these insects and other animals were created exactly *as* they are, and originally placed exactly *where* they are, by the inscrutable will of their Creator, and that we have nothing to do but to register the facts and wonder? Was this single island selected for a fantastic display of creative power, merely to excite a child-like and unreasoning admiration? Is all this appearance of gradual modification by the action of natural causes—a modification the successive steps of which we can almost trace—all delusive? Is this harmony between the most diverse groups, all presenting analogous phenomena, and indicating a dependence upon physical changes of which we have independent evidence, all false testimony? If I could think so, the study of nature would have lost for me its greatest charm. I should feel as would the geologist, if you could convince him that his interpretation of the earth's past history was all a delusion—that strata were never formed in the primeval ocean, and that the fossils he so carefully collects and studies are no true record of a former living world, but were all created just as they now are, and in the rocks where he now finds them.

I must here express my own belief that none of these phenomena, however apparently isolated or insignificant, can ever stand alone—that not the wing of a butterfly can change in form, or vary in colour, except in harmony with, and as a part of, the grand march of nature. I believe, therefore, that all the curious phenomena I have just recapitulated are immediately dependent on the last series of changes, organic and inorganic, in these regions; and as the phenomena presented by the island of Celebes differ from those of all the surrounding islands, it can, I conceive, only be because the past history of Celebes has been to some extent unique and different from theirs. We must have much more evidence to determine exactly in what that difference has consisted. At present, I only see my way clear to one deduction, viz., that Celebes represents one of the oldest parts of the archipelago, that it has been formerly more completely isolated both from India and from Australia than it is now, and that, amid all the mutations it has undergone, a relic or substratum of the fauna and flora of some more ancient land has been here preserved to us.

It is only since my return home, and since I have been able to compare the productions of Celebes side by side with those of the surrounding islands, that I have been fully impressed with their peculiarity, and the great interest that attaches to them. The plants and the reptiles are still almost unknown; and it is to be hoped that some enterprising naturalist may soon devote himself to their study. The geology of the country would also be well worth exploring, and its recent fossils would be of especial interest as elucidating the changes which have led to its present anomalous condition. This island stands, as it were, upon the boundary-line between two worlds. On one side is that ancient Australian fauna which preserves to the present day the facies of an early geological epoch; on the other is the rich and varied fauna of Asia, which seems to contain, in every class and order, the most perfect and highly organized animals. Celebes has relations to both, yet strictly belongs to neither; it possesses characteristics which are altogether its own; and I am convinced that no single island upon the globe would so well repay a careful and detailed research into its past and present history.

In the following catalogue of the Malayan species of Papilionidæ I have included those from Woodlark Island, collected by M. Montrouzier, as that island comes fairly within the limits of the archipelago; while I exclude New Caledonia as belonging more to the Australian and Pacific fauna. I have given full particulars of the variation of the several species, and have described all new species, forms, varieties, and undescribed sexes. The distribution of each species is noted chiefly from my own observations*. As the full synonymy and references to almost every work on Lepidoptera are given in the British Museum List of Papilionidæ, I have not thought it necessary to do more than to refer to a good figure and description in well-known works; and I have quoted Boisduval's 'Species Général des Lépidoptères' throughout. In all cases, however, where I have myself corrected the synonymy, or determined sexes which had been before improperly located, I have given much fuller references.

I have found it necessary to describe and name twenty new species, and to separate six or seven more which have been hitherto considered as varieties or sexes of other species. I have also described and separated twenty-five local forms or races, and twenty polymorphous forms or sexes, as well as several simple varieties. On the other hand, I have reduced fourteen species, which figure in some of our latest lists, to the rank of sexes or local or polymorphic forms of other species. For convenience of reference, I add a list of these, with a reference to the page where will be found the reasons for not adopting them.

Ornithoptera Pronomus, *G. R. Gray*, = O. Poseidon, *Db.* (var.), p. 36.
Ornithoptera Archideus, *G. R. Gray*, = O. Poseidon, *Db.* (var.), p. 36.
Ornithoptera Euphorion, *G. R. Gray*, = O. Poseidon, *Db.* (♀ var.), p. 36.
Ornithoptera Amphimedon, *Cr.*, = O. Helena, *L.* ♀, p. 38.
Papilio Hegemon, *G. R. Gray*, = P. Polyphontes, *Bd.*, p. 43.

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* Species collected by myself have (Wall.) after the localities where I have found them.

Papilio Melanides, *De Haan*, = P. Theseus, *Fab.* (♀ form), p. 53.
Papilio Romulus, *Cr.*, = P. Pammon, *L.* (♀ form), p. 52.
Papilio Rumanzovia, *Eschsch.*, = P. Emalthion, *Hübn.* (♀ form), p. 48.
Papilio Polytes, *L.*, = P. Pammon, *L.*, ♀, p. 51.
Papilio Orophanes, *Bd.*, = P. Ambrax, *Bd.*, ♀, p. 54.
Papilio Elyros, *G. R. Gray*, = P. Alphenor, *Cr.* (♀ form), p. 53.
Papilio Amanga, *Bd.*, = P. Ormenus, *Guér.* (♀ form), p. 55.
Papilio Onesimus, *Hewits.*, = P. Ormenus, *Guér.* (♀ form), p. 55.
Papilio Drusius, *Cr.*, = P. Gambrisius, *Cr.*, ♀, p. 58.

As the arrangement of the species of *Papilio* which I have adopted in this paper is somewhat new, and I hope will be found to be more natural than those which have been previously used, I here add lists of the Indian and Australian species arranged in the same manner. Those already included in my Malayan list will be indicated thus, (Mal.), and printed in *italics*.

List of the PAPILIONIDÆ *of the Indian Region.*

1. Teinopalpus imperialis, *Hope*.
2. Ornithoptera Darsius, *G. R. G.* (Ceylon).
3. —— Rhadamanthus, *Bd.*
4. —— *Pompeus*, Cr. (Mal.).
5. —— *Amphrisius*, Cr. (Mal.).

Papilio (Sect. A).

Nox group.

6. Papilio *Varuna*, White (Mal.).
7. —— Aidoneus, *Db.*
8. —— Philoxenus, *G. R. G.*
9. —— Polyceutes, *Db.*
10. —— Dasarada, *Moore.*
11. —— Ravana, *Moore.*
12. —— Minereus, *G. R. G.*
13. —— Icarius, *Westw.*
14. —— Bootes, *Westw.*
15. —— Janaka, *Moore.*

Coon group.

16. Papilio Doubledayi, *Wall.*

Polydorus group.

17. Papilio Jophon, *G. R. G.* (Ceylon).
18. —— *Diphilus*, Esp. (Mal.).
19. —— Alcinous, *Klug.*
20. —— Mencius, *Feld.*
21. —— Hector, *L.*

Papilio (Sect. B).

Protenor group.

22. Papilio Protenor, *Cr.*
23. Papilio Elphenor, *Db.*
24. —— Rhetenor, *Westw.*
25. —— Sakontala, *Hewits.*

Peranthus group.

26. Papilio Crino, *Fab.* (Ceylon).
27. —— Bianor, *Cr.*
28. —— Polyctor, *Bd.*
29. —— Ganesa, *Db.*
30. —— Arcturus, *Westw.*
31. —— Paris, *L.*
32. —— Palinurus, *Fab.*?
33. —— Krishna, *Moore.*

Memnon group.

34. Papilio *Androgeus*, Cr. (Mal.).
35. —— Polymnestor, *Cr.* (Ceylon).
36. —— Demetrius, *Cr.*

Helenus group.

37. Papilio *Helenus*, L. (Mal.).
38. —— Chaon, *Westw.*
39. —— Castor, *Westw.*
40. —— *Nephelus*, Bd. (Mal.).

Pammon group.

41. Papilio *Pammon*, L. (Mal.).

Demolion group.

42. Papilio *Demolion*, Cr. (Mal.).

Papilio (Sect. C).

Erithonius group.

43. Papilio *Erithonius,* Cr. (Mal.).

Paradoxa group.

44. Papilio Telearchus, *Hewits.*
45. —— Slateri, *Hewits.*

Dissimilis group.

46. Papilio dissimilis, *L.*
47. —— Panope, *L.*
48. —— Lacedæmon, *Fab.*
49. —— Pollux, *Westw.*

Papilio (Sect. D).

Macareus group.

50. Papilio *Macareus,* God. (Mal.).
51. —— *Leucothoë,* Westw. (Mal.).
52. —— Megarus, *Westw.*
53. —— Agestor, *G. R. G.*
54. —— Epytides, *Hewits.*
55. —— Xenocles, *Db.*

Antiphates group.

56. Papilio *Antiphates,* Cr. (Mal.).
57. —— Agetes, *Westw.*
58. —— Anticrates, *Db.*
59. —— Orestes, *Fab.*
60. —— Alebion, *G. R. G.*
61. —— Glycerion, *G. R. G.*

Eurypylus group.

62. Papilio Gyas, *Westw.*
63. —— Evan, *Db.*
64. —— Cloanthus, *Westw.*
65. —— *Sarpedon,* L. (Mal.).
66. —— Chiron, *Wall.*
67. —— *Jason,* Esp. (Mal.).
68. —— *Agamemnon,* L. (Mal.).
69. —— *Rama,* Feld. (Mal.).

4. Chinese species.
61. Indian species.
4. Ceylon species.

List of the Papilionidæ *of the Australian Region.*

Ornithoptera (*Priamus group*).

1. Ornithoptera *Poseidon,* Db. (Mal.).
2. —— Richmondia, *G. R. G.*

Papilio (Sect. A).

Polydorus group.

3. Papilio *Leodamas,* Wall. (Mal.).
4. —— *Liris,* Godt. (Mal.).
5. —— Godartianus, *Bd.* (Pacific Islands).

Papilio (Sect. B).

Helenus group.

6. Papilio Capaneus, *Westw.*
7. —— Ilioneus, *Don.*

Ulysses group.

8. Papilio Ulyssinus, *Westw.*
9. —— Montrouzieri, *Bd.* (New Caledonia).

Pammon group.

10. Papilio Canopus, *Westw.*

Erectheus group.

11. Papilio Erectheus, *Don.*
12. —— Amyntor, *Bd.* (New Caledonia).

Papilio (Sect. C).

Erithonius group.

13. Papilio *Erithonius,* Cr. (Mal.).

Anactor group.

14. Papilio Anactor, *McL.*

Papilio (Sect. D).

Antiphates group.

15. Papilio Leosthenes, *Db.*
16. —— *Parmatus,* G. R. G. (Mal.).

Eurypylus group.

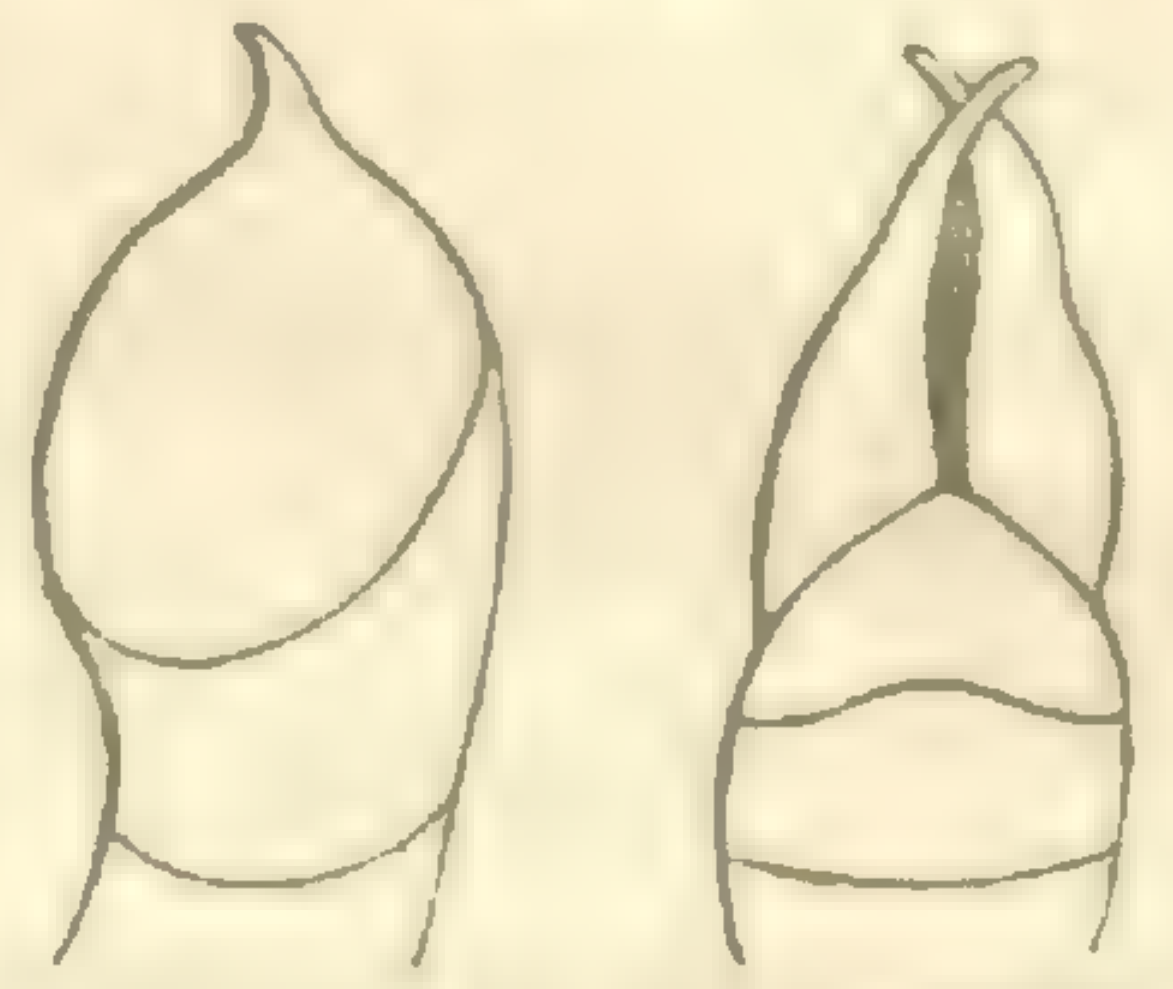
17. Papilio *Sarpedon,* L. (Mal.).
18. —— Gelon, *Bd.* (New Caledonia).
19. —— Lycaon, *Westw.*
20. —— Macleayanus, *Leach.*
21. —— Scottianus, *Feld.* (Ash Islands).
22. Eurycus Cressida, *Fab.*

6. Pacific Islands.
16. Australia.

Catalogue of Malayan PAPILIONIDÆ.

ORNITHOPTERA (Boisd.).

Fig. 1.



Anal valves of *O. Amphrisius.*

The characters in the *larva* and *pupa* which have been supposed to distinguish this genus from PAPILIO are erroneous, or at least do not exist in all the species. My own observations on *O. Poseidon* show that the *larva* has no "external sheath" to the thoracic tentacles, and that the suspending thread passes round the pupa, and is not "fastened on each side to a silky tubercle." There remain therefore only the characters of the perfect insect, the most important of which are the anal valves in the male. These are very large, ovate or rounded, coriaceous, and not hairy, and are furnished with projecting points or spines (sometimes very conspicuous) which serve to attach the male more firmly to the female *in copulâ.* In several species I have observed, these points or hooks were buried in the protruded anal gland of the female, and thus effectually prevented the great weight of the insects causing them to separate upon suddenly taking flight. The great strength and size of these insects, the thick texture of their wings, their long curved and stout antennæ, their peculiar form, colour, and distribution, are the only other characters that separate them from *Papilio.* Though these may not perhaps be technically sufficient, I think it advisable and convenient to retain a genus so well known and long established.

Ornithoptera is pre-eminently a Malayan genus, seventeen species inhabiting the archipelago, one (*Rhadamanthus*, Bd.) India and China, one (*Darsius*, G. R. Gray) peculiar to Ceylon, one (*Richmondia*, G. R. Gray) North Australia. *O. Victoriæ*, G. R. Gray, from some island east of New Guinea, should probably be included in the Malayan list; and *Æacus*, Felder, from an unknown locality. The following are the well-established Malayan species.

a. *Priamus* group.

1. ORNITHOPTERA PRIAMUS, Linnæus.

♂. *Papilio Priamus*, L.; Cram. Pap. Ex. t. 23. f. A, B; Godart, Enc. Méth. ix. p. 25. *O. Priamus*, Bd. Sp. Gén. Lép. p. 173.

♀. *P. Panthous*, L.; Cram. Pap. Ex. t. 123. f. A, t. 124. f. A.

This may be at once distinguished from all the allied species with which it has been often confounded—in the *male*, by the more rounded and deeply scalloped hind wings, with larger black spots and a broader border, the upper wings with no green on the median nervure or its branches, and the sooty patch extending only to the second median nervule; in the *female*, by the very constant and peculiar light olive-brown colour, the absence of any spots in the discoidal cell of the upper wings, and the broad shallow scallops of the hinder margin.

Hab. Amboyna and Ceram, probably also Bouru (*Wall.*).

2. ORNITHOPTERA POSEIDON, Doubleday.

O. Poseidon, Db. Ann. of Nat. Hist. xvi. p. 173; Westwood, Cat. of Orient. Ent. pl. 11, 14.

The numerous specimens of *Ornithoptera* which I obtained in various parts of New Guinea and the adjacent islands show so much instability of form, colouring, and even of neuration, no two individuals being exactly alike, that I am obliged to include them all in one variable species, to which I believe must also be referred *O. Pronomus*, G. R. Gray, from Cape York, *O. Euphorion*, G. R. Gray, from North Australia, *O. Archideus*, G. R. Gray (ex Boisd.), erroneously said to be from Celebes, and *O. Boisduvalii*, Montrouzier, from Woodlark Island.

Var. *a*, Aru Islands (*Wall.*). *O. Arruana*, Feld. Lep. Frag. p. 24.

Individuals from this locality differ in the arrangement of the nervures; in some the third subcostal nervure of the upper wings branches from the same point with the upper disco-cellular, in others considerably beyond it; the points from which the subcostal nervures branch also vary. The amount of green colour on the median nervure and its branches varies. In some specimens there is a spot at the anal angle of lower wings beneath, agreeing with *O. Pronomus*, G. R. Gray; but this is generally wanting.

Var. *b*, Dorey, Salwatty, south-west coast of New Guinea (*Wall.*).

These agree very closely with *O. Poseidon*, as figured by Westwood; they differ individually in the same manner as the last, and also in the length of the lower disco-cellular nervure on the under wings. They have generally no golden spots beneath the wings. They vary also in the outline of the under wings, the outer and anal angles being more acute in some specimens than in others. Some have the under wings of a uniform green entirely without spots, while others have a range of black spots more or less fully developed.

Var. *c*, Waigiou (*Wall.*). *Archideus*, G. R. Gray, ♀.

This agrees with the last; but the male is of a more delicate green than any of the others, and has less of that colour on the median veins. On the under side there are no golden spots. The whole surface has a golden tinge, and the central portion of the lower wings is tinged with amber-brown.

The females of all the above vary extremely, much more even than the males, and from the same locality two specimens are rarely alike. The discoidal cell is in some specimens more than half occupied by a whitish patch, while in others there are only a few small spots. One of my specimens from Salwatty almost exactly agrees with that figured by Westwood (Cat. of Or. Ent. pl. 14) as from Cape York. One of the Waigiou specimens is the same as *Archideus*, G. R. G., figured by Boisduval (Voy. de l'Astrolabe, t. 4. f. 1, 2); and another, from New Guinea, differs very little from *Euphorion*, G. R. G. (Brit. Mus. Cat. Lep. pt. 1. pl. 2. f. 3), from North Australia.

From these facts I am led to conclude that we have here a variable form spread over an extensive area, and kept variable by the continual intercrossing of individuals, which would otherwise segregate into distinct and sharply defined races. The same area is inhabited by many species of birds common to all parts of it; and just as the birds of Ceram and Amboyna are almost all distinct species from those of New Guinea, so do we find those islands inhabited by the *Ornithoptera Priamus*, a well-marked and constant species, readily distinguishable in either sex from the inconstant forms of New Guinea proper. The same parallel holds in North Australia. Many New Guinea species of birds extend, with very slight variation, to the country about Cape York; but when we reach the Moreton Bay district all these have disappeared, and we find only true Australian species. So the variable forms of *O. Poseidon* reach North Australia and Cape York, while in the Moreton Bay district we find the comparatively well-marked species *O. Richmondia*. Similar causes, whether geographical or climatal, have thus produced an analogous distribution in these widely separated groups of animals.

3. ORNITHOPTERA CRŒSUS, Felder.

O. Crœsus, Feld. Wien. Ent. Monats., Dec. 1859. *O. Crœsus,* G. R. Gray, Proc. Zool. Soc. 1859, p. 424.

Hab. Batchian (Moluccas) (*Wall.*).

Local form, *a.*—*Male*: has the orange colour of the upper surface of a much deeper fiery-red hue; on the under surface, the black spots of the lower wings are nearer the margin, and the yellow spots below them are entirely absent; there is also a green line between the subcostal nervure and the margin; on the under surface of the fore wings the green patch in the discoidal cell extends to its base, and is reflexed in a narrow line along its upper edge.

Female: differs still more from that sex in *O. Crœsus*; the white markings on all the wings are so large as almost to fill up the spaces between the veins, the lower part of the discoidal cell in both upper and under wings being also occupied with a whitish patch; the range of spots occupying the posterior margin are of a dusky yellow colour.

Hab. Ternate (♂), Gilolo (♀) (*Wall.*).

This well-marked local form is no doubt peculiar to Gilolo and the small adjacent islands, as the original species is to Batchian.

I was three months in the island of Batchian before I obtained a specimen of this fine insect, which I had seen once or twice only flying high in the air. I at length came upon it flying about a beautiful cinchonaceous shrub with white bracts and yellow flowers (*Mussœnda*, sp.); and having cleared a path round about, I visited the place every morning on my way to the forest, and once or twice a week had the satisfaction of capturing a fine male specimen of *O. Crœsus.* The females were more plentiful and more easily caught. I afterwards sent out one of my men with a net every day to look after this insect only. He would stay out all day long, wandering up a broad rocky torrent, where the males flew up and down occasionally or settled on the rocks which just appeared above the water. He generally brought me one, and sometimes even two or three specimens; and thus, with those that I myself captured at the flowers, I secured a fine series of this richly coloured species.

4. ORNITHOPTERA TITHONUS, De Haan.

O. Tithonus, De Haan, Verh. Nat. Gesch. Ned. t. 1. f. 1.

Hab. S.W. Coast of New Guinea (*Leyden Museum*).

This remarkable species must be very rare, as I never saw it in any part of the New

Guinea district that I visited; nor was it seen during the exploration, a few years ago, by a Dutch steamer which visited the part of the coast where the only specimen known was said to have been obtained.

5. Ornithoptera Urvilliana, Guérin.

Papilio Urvilliana, Guér. Voy. de la Coquille, Lép. t. 13. f. 1, 2, ♂.
O. Urvilliana, Boisd. Sp. Gén. Lép. p. 175.
Hab. New Ireland (*Paris Museum*).

b. *Pompeus* group.

6. Ornithoptera Remus, Cramer.

Papilio Remus, Cr. Pap. Ex. t. 135. f. A, t. 136. f. A (♀), t. 386. f. A, B (♂); Fab. Syst. Ent. iii. 1. p. 11
O. Remus, Bd. Sp. Gén. Lép. p. 176. *Papilio Panthous* ♂, Clerck, Icon. t. 18 (♀).
Hab. Amboyna, Ceram, Gilolo, Morty Island, Sulla Island, Celebes (*Wall.*).

The specimens above quoted agree well with Cramer's figures. The female from the Sulla Islands differs only in having more yellow towards the anal angle of the lower wings. The specimens figured by Cramer in pls. 10, 11, under the name of "*Hypolitus*" seem to be a remarkable variety, in which the female has much of the character of the male. Messrs. Doubleday and G. R. Gray have adopted *Panthous* as the specific name of this insect; but this name was first used by Linnæus for the female of *Priamus* only, in the 10th ed. of the 'Systema Naturæ' (1758). Clerck (in 1759) adopted the name, but supposed he had found the male in the female of *Remus.* Linnæus, in Mus. Lud. Ulric. (1764), and in the 12th ed. of the 'Systema Naturæ' (1766), adopts this error, so far as referring to Clerck's two figures; but in both these works his description refers only to the female of *P. Priamus,* indicating that the supposed other sex (*P. Remus*) was not known to him personally. The name of *Panthous* must therefore altogether drop, it having been applied to this species only through a double error—first, that of Linnæus, in supposing his *Panthous* to be distinct from *Priamus,* and then that of Clerck, in thinking that a female *Remus* was the male of the Linnean *Panthous.*

7. Ornithoptera Helena, Linnæus.

♂. *P. Helena,* Cram. Pap. Ex. t. 140. f. A, B. *O. Helena,* Boisd. Sp. Gén. Lép. p. 177.
♀. *P. Amphimedon,* Cram. Pap. Ex. t. 194. f. A. *O. Amphimedon,* Boisd. Sp. Gén. p. 176.
Hab. Amboyna and Ceram (*Wall.*).

The females from these localities are always sooty, with the spots and markings on the hinder wings of a dull buff-colour even in the freshest specimens.

a. Local form *Bouruensis.*—*Male*: exactly resembles the Amboyna specimens, except that the yellow patch is more variable in form and extent.

Female: nearly black, and with the markings on the lower wings almost as pure and deep yellow as in the males: size a little smaller than in the type.

Hab. Bouru (*Wall.*).

b. Local form *Papuensis.*—*Female*: sooty black, the two first branches of the subcostal nervure margined with whitish near their origin; markings of the lower wings of the same tint of orange-yellow as is *O. Helena* ♂, but not so glossy.

Male not known.

Hab. New Guinea, Salwatty (*Wall.*).

c. Local form *Celebensis.*—*Male*: wings a little more pointed than in *O. Helena*; yellow patch of lower wings extending nearer to the posterior margin, and bounded towards the abdominal margin by the first branch of the median nervure. Beneath, having the nervures between the discoidal cell and the outer border ashy-margined.

Female not known.

Hab. Macassar (Celebes) (*Wall.*).

Remarks.—Of these three local modifications of *O. Helena*, the first is very distinct in the female, but not separable in the male sex. Of the second and third, only one sex is known; and they may very probably prove to be well-marked species when more materials are obtained.

8. Ornithoptera Leda, n. s.

Male: upper wings elongate, triangular, glossy black, quite uniform and immaculate; the outer margin delicately white-marked at the termination of the nervures. Lower wings yellow, as in the allied species, with a black border about the same width as in *O. Pompeus* on the outer and abdominal margins, narrower on the inner margin; the posterior scalloping of the yellow patch not so deep as in *O. Pompeus*, and having a spot at the anal angle connected more or less with the margin.

The under surface differs from that of *O. Pompeus* by the ashy margins of the veins of the upper wings being entirely absent, and in having much less white on the outer edge. There are no submarginal spots except the anal one, much red at the base of the wings, and no black spots on the abdomen.

Female: this sex varies very much, some having the upper wings immaculate, while others have the veins about the end of the discoidal cell broadly margined with whitish. The marginal series of spots on the lower wings vary as they do in *O. Pompeus* and *O. Amphrisius*. The best distinction from *O. Pompeus* (♀) seems to be the more elongated wings, the less crenellated margin, and the more produced outer angle of the lower wings. The yellow patch is also of a deeper colour both on the upper and under surfaces.

Hab. Celebes (Macassar and Menado) (*Wall.*)

9. Ornithoptera Pompeus, Cramer.

P. Pompeus, Cr. Pap. Ex. t. 25. f. A (♂). *P. Minos*, Cr. Pap. Ex. t. 195, f. A (♀). *P. Heliacon*, Fab. Ent. Syst. 3. i. p. 19, 60.

O. Heliacon, Boisd. Sp. Gén. Lép. p. 178.

Hab. Sumatra, Borneo, Java, Lombock (*Wall.*), India (var.).

Remark.—The form that occurs in India, in its more elongate wings and darker colouring, approaches very closely to *O. Rhadamanthus*.

10. ORNITHOPTERA NEPHEREUS, G. R. Gray.

P. Astenous, Eschscholtz, Voy. Kotzebue, t. 4. f. A, B, C. (nec Fab.).
O. Nephereus, G. R. G., List of Lep. B. M. Papilionidæ, p. 6.
Hab. Philippine Islands.

Remark.—This is quite distinct from *O. Rhadamanthus,* Bd., with which it has generally been identified.

11. ORNITHOPTERA MAGELLANUS, Felder.

O. Magellanus, Feld. Lep. Nov. Phil. p. 11.
Hab. North of Luzon (Philippines).

Remark.—This fine species has a beautiful opalescent glow on the lower wings when viewed obliquely.

12. ORNITHOPTERA CRITON, Felder.

O. Criton, Feld. Lep. Fragm. p. 49.
Hab. Batchian, Ternate, Gilolo, Morty Island (*Wall.*).

13. ORNITHOPTERA PLATO, n. s.

Male : resembles *O. Criton* in the form and extent of the yellow patch, but the upper wings differ in having the outer half of a lighter tint; on the under surface this outer half of the wing is of a light ash-colour. Abdomen almost wholly black beneath. No red patches at the base of the wings, or any red collar.

Female unknown.

Hab. Timor (*Wall.*).

This is a very distinct species, though at first sight resembling several others. I obtained a single male specimen only.

14. ORNITHOPTERA HALIPHRON, Boisduval.

O. Haliphron, Bd. Sp. Gén. Lép. p. 181 (♂) ; Felder, Lep. Fragm. p. 37, Taf. ii. f. 2, 3 (♂, ♀).
Hab. Macassar (Celebes) (*Wall.*).

15. ORNITHOPTERA AMPHRISIUS, Cramer.

P. Amphrisius, Cr. Pap. Ex. t. 219. f. A; Godardt, Enc. Méth. ix. p. 27, pt.
O. Amphrisius, Bd. Sp. Gén. Lép. p. 178.
Hab. Malacca, Java, Borneo (*Wall.*).

This may be readily distinguished from the allied species by the upper wings in the male being yellow-marked, and by the absence of red spots at the base of the wings beneath in both sexes.

c. *Brookeana* group.

16. ORNITHOPTERA BROOKEANA, Wallace.

O. Brookeana, Wall. Proc. Ent. Soc. 1855, p. 104; Hewitson, Ex. Butt. Papilionidæ, i. f. 1. *Papilio Trogon,* V. Voll. Tijdschrift voor Ent. 1860, p. 69, pl. 6.
Hab. Borneo (Sarawak) (*Wall.*), Sumatra (*Leyden Museum*).

Remarks.—I have been in much doubt about the position of this remarkable species, and was for some time inclined to place it among the Papilios. It agrees, however, far better with *Ornithoptera* in the form and stoutness of the wings, the long stout and curved antennæ, the red collar and patches at the base of the wings beneath, the abdominal fold, and the flight and general appearance. It is powerful on the wing, and occasionally settles on the ground in damp sunny places. It inhabits the interior of North-west Borneo and the mountains of West Sumatra. The female is unknown. It is peculiar in the great length of the discoidal cell of the wings and its altogether unique style of coloration, and must be considered as the type of a distinct group of the genus *Ornithoptera.*

PAPILIO.

This is without doubt the finest and most remarkable genus of Diurnal Lepidoptera. About 360 species are now known, all, except ten, being tropical or subtropical. I have given at p. 23 the characters of the sections and groups into which I divide the Malayan species.

SECTION A.

a. *Nox* group.

17. PAPILIO NOX, Swainson.

P. Nox, Sw. Zool. Ill. pl. 102; Horsf. Lep. Ins. E. I. C. pl. 1. f. 1; Boisd. Sp. Gén. Lép. p. 277.
P. Neesius, Zink. Nov. Act. Acad. Nat. Cur. xv. t. 14. f. 1.
Hab. Java (♂, ♀) (*Wall.*), Penang (♂) (*Brit. Mus.*).

18. PAPILIO NOCTIS, Hewitson. Tab. V. fig. 1 (♂)*.

P. Noctis, Hewits. Proc. Zool. Soc. 1859, p. 423, pl. 66. f. 5 (♀).

Male: differs from the same sex of *P. Nox* by the broader apex of the fore wings, and by the hind wings being more elongate, more glossy, and especially by the entire non-dentated hinder margin.

Hab. Borneo (Sarawak) (*Wall.*), (♂, ♀ Mus. nost.)

19. PAPILIO EREBUS, Wallace.

P. Nox, var., De Haan, Verh. Nat. Gesch. t. 5. f. 3 (♀).
Hab. Malacca (*Wall.*), Banjermassing, Borneo (*De Haan*).

Remarks.—I am somewhat doubtful of the species, the female only being known; but it differs so strikingly from the same sex of *P. Nox* and *P. Noctis* (the former of which seems very constant), that I think it better to separate it in order to draw attention to other specimens that may exist in collections. It differs from *P. Nox* (♀) by its narrower and more elongate hind wings, which are black, glossed with steel-blue; the fore wings are black, with the veins beyond the cell clearly white-margined. The lower margin is also much less strongly dentated.

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* In all the Plates, the wings on one side of each figure are detached from the body, and represent the *under surface* of the same insect. In one case only (Tab. VII. f. 1.) the upper surfaces of two varieties of the same species are given.

20. Papilio Varuna, White.

♀. *P. Varuna,* Wh., Entomologist, 1842, p. 280; Westw. Ann. Nat. Hist. ix. p. 37. *P. Chara,* Westw. Arc. Ent. pl. 66. f. 2.

♂. *P. Astorion,* Westw. Ann. Nat. Hist. ix. p. 37; Arc. Ent. pl. 66. f. 1.

Hab. Pulo Penang, Sylhet.

21. Papilio Semperi, Felder.

P. Semperi, Feld. Lep. Nov. Philipp. pp. 1, 11.

Hab. Luzon, Philippines (♂, ♀).

N.B. The *Philoxenus* group peculiar to India follows on after these.

b. *Coon* group.

22. Papilio Neptunus, Guérin.

P. Neptunus, Guér. Deless. Voy. dans l'Inde, p. 69, t. 19 (*P. Saturnus*).

Hab. Malacca, Borneo (♂, ♀) (*Wall.*).

23. Papilio Coon, Fabricius.

P. Coon, Fab. Ent. Syst. iii. 1. pp. 10, 27; Don. Ins. China, pl. 24. f. 1; Lucas, Lep. Ex. t. 6. f. 2; Boisd. Sp. Gén. Lép. p. 201.

Hab. Java, Sumatra (*Wall.*), Borneo (*De Haan*).

Remarks.—The specimens from Sumatra are constantly larger than those from Java. The Indian form, in which the markings are red instead of yellow, with other differences, I consider a distinct species, for which I propose the name of *P. Doubledayi,* after the late Mr. Edward Doubleday of the British Museum *.

c. *Polydorus* group.

24. Papilio Polydorus, Linnæus.

P. Polydorus, L.; Clerck, Icon. t. 33. f. 3. *P. Leobates,* Reinw. Verh. Nat. Gesch. Zool. t. 6. f. 3 (♀).

Hab. Ceram, Matabello Island, Bouru, Batchian (♂, ♀) (*Wall.*).

Local form or variety *a.*—The white markings on the fore wings forming a patch below the cell; red spots on the hind wings nearer to the posterior margin and that next the anal angle larger.

Hab. Ke Island, Aru Island (♂, ♀) (*Wall.*).

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* **Papilio Doubledayi,** Wallace. (*P. Coon,* var., B. M. Cat.)

Above: upper wings as in *P. Coon,* but the base darker. Lower wings broader than in *P. Coon*; the white spot in the cell toothed below, and divided by one or two faint blackish lines, cut off at the middle of the cell by the black triangular basal patch. The marginal spot next within the tail wanting; the two anal spots, end of abdomen, and its rings (which are yellow in *P. Coon*) red; collar behind the eyes and palpi (which are black in *P. Coon*) also red.

Beneath: base of lower wings broadly black; white spots all much broader and rounder than in *P. Coon*; sides of the thorax, end of the abdomen, and the marginal spots in the caudal and anal region red.

The female differs in a corresponding manner from *P. Coon* ♀. Size about the same.

Hab. Moulmein, Assam.

25. Papilio Leodamas, n. s. Tab. V. fig. 2 (♂).

P. Polydorus, in Brit. Mus. List of Papilionidæ, p. 10.

Male. Above, glossy black, upper wings immaculate (the veins pale-margined in the female). Lower wings with a rounded white spot divided into six parts by fine nervures, of which the outermost and that in the cell are sometimes reduced to points; marginal row of red spots obscured with black, and but faintly indicated.

Beneath, the white patch has a small red spot attached to the part next the anal angle; and the marginal row of six red spots are clearly marked, that at the anal angle being twice the size of the rest. Wings short, much rounded, scarcely or not at all produced in the caudal region.

Expanse of wings $3\frac{3}{4}$ in. to 4 in.

Hab. New Guinea, Mysol (♂, ♀) (*Wall.*), Rockingham Bay (Australia), (*Brit. Mus.*, ♀).

26. Papilio Diphilus, Esper.

P. Diphilus, Esp. Ausl. Schmett. t. 40. f. 1. *P. Polydorus*, Boisd. Sp. Gén. Lép. p. 267; and most authors.

Hab. Java, Malacca (*Wall.*), Philippine Islands, India.

Remarks.—The specimens from Manilla are larger, and the females paler-coloured, than those from other localities, all of which have slight characteristic peculiarities; but they also vary in the individuals from each locality, so that no perfect segregation of local forms has yet taken place.

27. Papilio Antiphus, Fabricius.

P. Antiphus, Fab. Syst. Ent. iii. 1. pp. 10–28; Boisd. Sp. Gén. Lép. p. 266.

Hab. Sumatra, Borneo, Lombock, Java (*Wall.*), Philippine Islands.

Remarks.—The Philippine form (*P. Kotzebuea*, Eschsch.) is rather larger and of a more uniform glossy black than those from other localities. *P. Theseus*, Cram., has been erroneously supposed to be the female of this species, whereas it is the female of one of the *Pammon* group, belonging to a different section of the genus. De Haan figures *P. Theseus* as *P. Antiphus* ♀, in Verh. Nat. Gesch. t. 8. f. 2. As has been already pointed out, *P. Theseus* mimics this species.

28. Papilio Polyphontes, Boisduval.

P. Polyphontes, Bd. Sp. Gén. Lép. p. 268. *P. Hegemon*, G. R. G., List of Papilionidæ in B. Mus.

Hab. Celebes, Batchian, Morty Isl. (♂, ♀) (*Wall.*).

Remarks.—The markings vary from pure white to a smoky tint; but otherwise all the specimens from the above localities agree. De Haan gives (Verh. Nat. Gesch. t. 8. f. 4) a female of one of the *Pammon* group as *P. Polyphontes* ♀.

29. Papilio Annæ, Felder.

P. Annæ, Feld. Lep. Nov. Philipp. p. 1.

Hab. Mindoro (Philippines).

30. Papilio Liris, Godart.

P. Liris, God. Enc. Méth. iv. p. 72; Boisd. Sp. Gén. Lép. p. 268; De Haan, Verh. Nat. Gesch. p. 38, t. 4. f. 3 (♀).

Hab. Timor (*Wall.*), N.W. Australia (*Brit. Mus.*).

Remarks.—The Australian specimens are smaller. The female of *P. Œnomaus* mimics this species, as has been already mentioned (p. 22). Both species were taken by myself on the same spot, and, though such large and conspicuous insects, they could never be distinguished without a close examination after capture. The female of this species differs very little from the male, being rather larger, with broader wings and less vivid coloration.

Section B.

d. *Ulysses* group.

31. Papilio Ulysses, Linnæus.

P. Ulysses, L., Cramer, Pap. Ex. t. 121. f. A, B (♀), t. 122 A (♀). *P. Diomedes*, Boisd. Sp. Gén. Lép. p. 202.

Hab. Amboyna, Ceram (♂, ♀) (*Wall.*).

Remark.—The largest specimens of this glorious insect are found in the island of Amboyna, where it is rather common, hovering about the forest pathways. It sometimes visits the gardens in the town of Amboyna.

32. Papilio Penelope, n. s.

Male: rather smaller than *P. Ulysses*. Upper wings with six black cottony patches, and all separate from each other; whereas in *P. Ulysses* there are seven, and the four lower ones are always united at their margins. The blue colour fills the discoidal cell, and generally extends beyond it at the extremity; the upper disco-cellular nervure not black-bordered as in *P. Ulysses*. Lower wings with the blue colour extending further along the abdominal margin, and not quite so far towards the outer angle.

Female: has the blue colour of the same form and extent as in *P. Ulysses* ♀, but of the same bright tint as in the male; the marginal lunules more deeply curved.

Expanse of wings 5 inches.

Hab. New Guinea, Waigiou, Aru Is. (♂, ♀) (*Wall.*).

Remark.—As all the other forms closely allied to *P. Ulysses* have received names (*Telemachus*, Montr., *Chaudoiri*, Feld., *Telegonus*, Feld., and *Ulyssinus*, Westw.), I have also given one to this form peculiar to New Guinea and the Papuan Islands, the distinctive characters of which, though very slight, seem sufficiently constant.

33. Papilio Telegonus, Felder.

P. Telegonus, Feld. Lep. Fragm. p. 50.

Hab. Batchian, Gilolo (♂, ♀) (*Wall.*).

Remark.—A very distinct species, separated from *P. Ulysses* by the extent of the cottony patch on the upper wings, and by the different form and colour of the blue markings.

34. Papilio Telemachus, Montrouzier.

P. Telemachus, Mont. Ann. de la Soc. d'Agriculture de Lyon, 1856, p. 395.

Hab. Woodlark Isl. (S. E. of New Guinea).

Remark.—This is a small species (exp. 4 in.), with less blue on the lower wings.

e. *Peranthus* group.

35. Papilio Peranthus, Fabricius.

P. Peranthus, Fab. Syst. Ent. iii. 1. p. 15; Don. Ins. China, pl. 26; Lucas, Lep. Ex. t. 12. f. 2; Boisd. Sp. Gén. Lép. p. 203.

Hab. Java, Lombock (*Wall.*).

36. Papilio Pericles, n. sp. Tab. VI. fig. 1 (♂).

Wings more elongate, and upper wings more pointed, than in *P. Peranthus.*

Above black, the basal half of a silvery blue, greenish towards the base of the costa, and purplish on the outer margin, where on the lower wings it shades off into separate scales. On the submedian and two lower branches of the median nervure are elongate black cottony patches as in *P. Ulysses,* the lower ones joined at the base, the upper one separate; above these the outer margin is of a brown black, with a few atoms of yellow and blue scales towards the apex; the blue colour extends beyond the discoidal cell of the upper wings in a line parallel with the outer margin, on the lower wings it rounds away to the anal angle, and below it are five submarginal lunules of blue atoms, the outer one almost obsolete, and that next the tail largest and most deeply coloured. Thorax and body green.

Beneath as in *P. Peranthus,* but the posterior range of lunules margined with brilliant blue and orange brown.

Expanse of wings 3½ inches.

Hab. Timor (♂) (*Wall.*).

37. Papilio Philippus, Wallace. Tab. VI. fig. 3.

P. Peranthus, var. A, Boisd. Sp. Gén. Lép. p. 204.

Above: basal half of the wings of a rich green-blue, the rest black, with a triangular patch at the apex of the uppers, formed of green atoms situated between the nervures; on the lower wings six large submarginal lunules, the lowest of which sends out some green atoms along the tail. The black cottony spot is of a different form from that of *P. Peranthus,* the separate patches being only joined in the middle, and two of them extending along the nervures in a point nearly to the discoidal cell.

Beneath brilliantly marked with lunules of buff, black, and blue.

Expanse of wings 4½–5 inches.

Hab. Moluccas (*Wall.*).

Remarks.—My specimen from Ceram is of a greener tinge, and the colour extends a little beyond the end of the discoidal cell; that from Batchian is smaller, of a bluer tinge, and the colour of less extent. The species seems to be very rare.

38. Papilio Macedon, Wallace. Tab. VI. fig. 2 (♂).
P. Peranthus, var. B., Boisd. Sp. Gén. Lép. p. 204.

Boisduval's description sufficiently shows the remarkable differences of form, size, and colouring which this species presents, compared with that of which he considers it a variety. The female agrees with the male, except that the colours are a little less brilliant, and the cottony patches of the fore wings are absent.

Expanse of wings, ♂, 5 inches; ♀, 5–6 inches.

Hab. Macassar, Menado (Celebes) (*Wall.*).

39. Papilio Brama, Guérin.

P. Brama, Guér. Rev. Zool. 1840, p. 43, t. 1. f. 3, 4. *P. Palinurus*, De Haan, Verh. Nat. Gesch. pp. 5, 29.
Hab. Malacca, Sumatra (*Wall.*).

40. Papilio Dædalus, Felder.
P. Dædalus, Feld. Lep. Nov. Philipp. p. 2.
Hab. Luzon (Philippine Islands).

41. Papilio Blumei, Boisduval. Tab. VI. fig. 4 (♂).
P. Blumei, Boisd. Sp. Gén. Lép. p. 206.
Hab. Menado (Celebes) (*Wall.*). "Amboyna," *Bd.*, error of locality.

Remark.—This very fine species comes nearest to the last, but is of much larger size, and is conspicuous by its brilliantly coloured tails.

42. Papilio Arjuna, Horsfield.

P. Arjuna, Horsf. Cat. Lep. E. I. Comp. pl. 1. f. 14; Boisd. Sp. Gén. Lép. p. 209. *P. Arjuna*, var. *a.*, Brit. Mus. Cat. of Papilionidæ, p. 17.
Hab. Java, Borneo, Sumatra (*Wall.*).

The Bornean form differs from that of Java by its larger size, and on the under surface by the three middle lunules being formed of a violet line only, with scarcely a trace of red beneath it, and by the orange-red lunules both at the anal and outer angles being divided (not margined) by a violet line. The scales sprinkled at the base of the lower wings are white and blue, and are neither so dense nor do they extend so far as the yellowish scales of the Java specimens. In all these particulars the Sumatra specimens are somewhat intermediate, but approach most to those of Borneo. This is one of the examples which show the isolation of Java, notwithstanding its proximity to Sumatra.

f. *Memnon* group.

(N.B. The *Protenor* group of India is intermediate between this and the last group.)

43. Papilio Memnon, Linnæus. Tab. I. figs. 1 (♂), 2, 3, 4 (♀s).
♂, *P. Memnon*, L., Cram. Pap. Ex. t. 91. f. C (♂); Boisd. Sp. Gén. Lép. p. 192.
♀, 1st dimorphic form, *P. Anceus*, Cr. Pap. Ex. t. 222. f. A, B.
?*P. Laomedon*, Cr. Pap. Ex. t. 50. f. A, B.; De Haan, Verh. Nat. Gesch. p. 24, t. 3. f. 2.

♀, 2nd dimorphic form, *P. Achates,* Cr. Pap. Ex. t. 243. A.
Hab. Java, Sumatra (*Wall.*).

Local form *a.—Male*: border of posterior wings beneath narrow and of an ashy-blue colour.

Female: near *P. Anceus,* Cr., and *P. Laomedon,* Cr., but of an olive-ashy colour.
Hab. Borneo (*Wall.*).

Local form *b.—Male*: band on under side of posterior wings ashy; the spots large, with reddish-orange lunules between the two series, and below the four outer ones.
Hab. Lombock (*Wall.*).

Remarks.—The difference between the male and the 2nd form of female is so great, both in form and colouring, that they could not have been imagined to be the same, had they not been bred from the same larvæ. They have also been taken "*in copulâ*" by myself. Each form varies considerably, both individually and locally; yet there are none intermediate between the two. I consider them, therefore, as presenting a fine instance of dimorphism; and I also believe that the second form mimics *P. Coon*, for reasons which I have explained at p. 21.

44. PAPILIO ANDROGEUS, Cramer.

♂, P. *Androgeus,* Cr. Pap. Ex. t. 91. f. A, B.
♀, 1st dimorphic form, *P. Agenor,* L., Cr. Pap. Ex. t. 32. f. A, B.
♀, 2nd dimorphic form, *P. Achates,* Cr. Pap. Ex. t. 182. f. A, B; *P. Alcanor,* Cr. Pap. Ex. t. 166, f. A.
Hab. Malacca (*Wall.*), India.

Remarks.—Ever since it was discovered that the insects figured by the old authors as *P. Anceus, P. Agenor, P. Achates,* &c. were varying females of *P. Memnon* and *P. Androgeus,* the whole of these were very naturally concluded to belong to one varying species. An examination of many extensive collections, however, has convinced me that the continental forms, on the one hand, and the insular ones, on the other, can be readily distinguished, and really form two very well-marked species. The red lunules at the anal region beneath characterize all specimens from India (*Androgeus,* Cr.), while these are entirely absent in all the insular specimens (*Memnon,* Cr.); and the same characteristic difference can be traced in a greater or less degree throughout all the infinitely varying female specimens. My specimen from Malacca has a faint trace only on the upper surface of the characteristic red mark at the base of the anterior wings; in other respects it resembles the continental individuals. This form mimics the Indian form of *P. Coon* (*P. Doubledayi,* Wall.).

45. PAPILIO LAMPSACUS, Boisduval.

P. Lampsacus, Bd. Sp. Gén. Lép. p. 190; De Haan, Verh. Nat. Gesch. p. 23, t. 2. f. 2.
Hab. Java (♂) (*Wall.*).

46. PAPILIO PRIAPUS, Boisduval.

P. Priapas, Bd. Sp. Gén. Lép. p. 190; De Haan, Verh. Nat. Gesch. p. 23, t. 2. f. 1.
Hab. Java (*Boisd.*), Sumatra (*Raffles*), Borneo (*De Haan*).

47. Papilio Emalthion, Hübner.

♂, *Iliades Emalthion,* Hübn. Samml. Exot. ii. t. 117; *P. Emalthion,* Boisd. Sp. Gén. Lép. p. 196; *P. Floridor,* Godt. Enc. Méthod. ix. p. 809; *P. Kruscusterina* in Eschsch. Voy. Kotzebue, t. 3. f. 5.

♀, 1st form, *P. Emalthion,* Cat. of Lep. Brit. Mus. pl. 5. f. 4.

♀, 2nd form, *P. Rumanzovia,* Eschsch. Voy. Kotz. t. 2. f. 4; *P. Descombesi,* Boisd. Sp. Gén. p. 197; *P. Floridor,* ♀. Godt. Enc. Meth. ii. p. 809.

Hab. Philippine Islands.

Remarks.—I have no doubt whatever that we have here another case of dimorphism, and I therefore unhesitatingly place these supposed species under one name. The male of *P. Emalthion* very closely resembles the next species (*P. Deiphontes*), and the 2nd form of female (*P. Rumanzovia,* Eschsch.) as closely resembles the female of the same species; so that there can be no doubt that Godardt was right in describing them as the sexes of his *P. Floridor.* The female figured in the British Museum Catalogue is intermediate between these, but has more of the characters of the male; and it is to be remarked that both these forms of female have arrived in Europe accompanied by the same male. I am therefore obliged to reduce by one the hitherto received species of Philippine Papilios.

48. Papilio Deiphontes, n. s.

P. Deiphobus, var. A., Bd. Sp. Gén. Lép. p. 201.

♂. *Above*: exactly as in *P. Deiphobus,* but having a small tooth only in place of the tail, and the posterior band of a clear ashy blue.

Beneath: with the markings as in *P. Emalthion,* except that the red patch at the base of the upper wings is smaller.

♀. Also tailless, but resembling in markings the same sex of *P. Deiphobus,* the pale patch on the upper wings not extending into the discoidal cell.

Expanse of wings, ♂, $5\frac{1}{2}$ inches; ♀, $5\frac{3}{4}$ inches.

Hab. Batchian, Gilolo, Ternate, Morty Isl. (*Wall.*).

49. Papilio Deiphobus, Linnæus.

P. Deiphobus, L., Cramer, Pap. Ex. t. 181. f. A, B; Donovan, Ins. Ind. pl. 17. f. 2; Lucas, Lep. Ex. t. 11; Boisd. Sp. Gén. Lép. p. 200.

♀, *P. Alcandor,* Cr. Pap. Ex. t. 40. f. A, B.

Hab. Ceram, Amboyna, Bouru (*Wall.*).

Remark.—A simple variety of both this and the last species frequently occurs, in which all the markings on the under side are ochre-yellow instead of red.

50. Papilio Ascalaphus, Boisduval.

P. Ascalaphus, Bd. Sp. Gén. Lép. p. 200 (♂); De Haan, Verh. Nat. Gesch. p. 26, t. 1. f. 2 (♀).

Hab. Menado, Macassar (Celebes), Sulla Isl. (*Wall.*).

51. Papilio Œnomaus, Godardt.

P. Œnomaus, Godt. Encyc. Méth. ix. p. 72; Boisd. Sp. Gén. Lép. p. 190; De Haan, Verh. Nat. Gesch. p. 24, t. 4. f. 1 (♂), 2 (♀).

Hab. Timor (♂, ♀) (*Wall.*).

Remark.—As has been already noticed (p. 22), the female of this species closely resembles *P. Liris* ♀, in company with which it was captured.

g. *Helenus* group.

52. Papilio Severus, Cramer.

P. Severus, Cr. Pap. Ex. t. 227. f. A, B (♂), t. 278. f. A, B (♀); Boisd. Sp. Gén. Lép. p. 212.
Hab. Bouru, Ceram, Amboyna, Gilolo, Batchian, Aru Isl. (*Wall.*).

Remarks.—This species exhibits a large amount of simple variation, in the presence or absence of a pale patch on the uppers, in the brown submarginal marks on the lower wings, in the form and extent of the yellow band, and in the size of the specimens. The most extreme forms, as well as the intermediate ones, are often found in one locality and in company with each other, indicating that over the above range continual intermixture probably takes place, and thus prevents any one form from becoming specialized in a restricted area. The two following modifications of it, however, have acquired perfect stability, each in a large island situated on the extreme limits of the species. I therefore consider them to be distinct, though the actual differences are but small.

53. Papilio Pertinax, n. s. Tab. V. fig. 4 (♂).

Upper side: anterior wings rather more elongate and pointed than in *P. Severus*, dusky brown, with faint longitudinal rows of yellow scales in the cell, and with rather denser scales between the nervures beyond it; these are condensed into a narrow yellowish band parallel to the outer margin, and rather nearer to the cell than to it. Hind wings black, with three yellowish white subquadrate spots (the upper one smallest) situate between the outer angle and the discoidal nervule; beyond these and continued to the anal angle are a few very faint and minute groups of scales.

Under side as above, but the transverse band on the upper wings is whiter, and on the lower wings are seven submarginal brownish-yellow lunules, the middle ones least marked, and those at the outer and anal angles having above them a very small group of minute blue scales.

The female is paler-coloured, with the markings rather more diffused, and has on the under side an imperfect ocellus at the anal angle, a row of faint brown lunules extending to the three white spots, and two irregular lunules of blue atoms below those next the abdominal margin.

Expanse of wings, ♂, 4¼ inches; ♀, 5 inches.
Hab. Macassar (Celebes) (*Wall.*).

Remark.—This species was rather abundant near Macassar, in woody places, and was very constant in its markings and general aspect.

54. Papilio albinus, n. s. Tab. V. fig. 5 (♂).

Wings broader than in *P. Severus*, costa less arched, tail smaller, and the caudal margin less produced.

Upper side brown-black; anterior wings with very faint horizontal lines of yellowish scales in the cell; apical portion of the wing more thickly powdered between the nervures, the powdering fading away towards the outer angle. Posterior wings with a large yellowish-white patch, commencing close to the anterior margin, widening in the middle so as to cross the end of the cell, and ending in a triangle with prolonged apex at the abdominal margin; the outer edge of this spot is regularly angulated and scalloped; two very faint brown lunules occur next the anal angle; and the outer margin is rather broadly white-edged between the dentations.

Under side: the anterior wings have distinct greyish lines of scales between the nervures in the apical region; posterior wings not dotted with scales as in *P. Severus*, but with two or three single rows of scales in the cell only; the yellowish band consisting of a lunule next the upper margin, followed by three rhomboidal spots notched below, of which the middle one is the largest, then a roundish spot and a small horizontal mark; a row of seven submarginal lunules, of which the three middle ones are smallest and nearly obsolete, and that at the anal angle much the largest and, with the whitish marginal spot below it, forming an incomplete ocellus.

Expanse of wings 3½–3¾ inches.

Hab. New Guinea (♂) (*Wall.*).

55. Papilio Phestus, Guérin.

P. Phestus, Guér. Voyage de la Coquille, t. 14. f. 2; Bd. Voy. de l'Astrolabe, i. p. 41; Sp. Gén. Lép. p. 212.

Hab. New Guinea (*Paris Museum*).

56. Papilio Helenus, Linnæus.

P. Helenus, L.; Cramer, Pap. Ex. t. 153. f. A, B; Lucas, Lep. Ex. t. 15. f. 2; Boisd. Sp. Gén. Lép. p. 211.

Hab. China ("*type,*" *Cramer's figure*).

Local form *a*. Has more falcate wings and longer tail; the red marks at the anal angle beneath are divided by a violet-white mark.

Hab. North India.

Local form *b*. Same form of wings as the last, but smaller; the third and fourth lunules from the anal angle beneath very small or quite absent.

Hab. Java, Sumatra (*Wall.*).

57. Papilio Hecuba, n. s. Tab. V. fig. 3 (♂).

Upper wings falcate, and their outer margin much hollowed out, as in many of the Celebes butterflies.

♂. *Upper side*: the outer half of the anterior wings of a fine cottony texture, as in *P. Helenus*, but more marked; the red lunule at the anal angle wanting; the rest as in *P. Helenus*.

Under side: the lunules and ocelli are ochre-yellow instead of deep red, the two outer ones very small, the third almost obsolete, and the next two absent; the anal ocellus is bordered with blue above, and adjoining it is a blue lunule in the place of the red one in *P. Helenus*.

♀. *Upper side* of a browner colour; two orange-brown ocelli at the anal angle.

Under side: the lunules and ocelli all larger; the two intermediate ones entirely absent, as in the male.

Expanse of wings 5½–5¾ inches.

Hab. Macassar, Menado (Celebes) (*Wall.*).

58. Papilio Iswara, White.

P. Iswara, White, Entom. 1842, p. 280; Doub. and Hew. Gen. of Diurn. Lep. pl. 2. f. 1 (♀).

Hab. Penang, Malacca, Singapore, Borneo (♂, ♀) (*Wall.*).

59. Papilio Hystaspes, Felder.

P. Hystaspes, Feld. Lep. Nov. Philipp. p. 12.

Hab. Luzon (Philippines).

This is the Philippine form of *P. Helenus*.

60. Papilio Araspes, Felder.

P. Araspes, Feld. Ent. Fragm. p. 17.

Hab. Philippine Islands.

This comes near to *P. Iswara*.

61. Papilio Nephelus, Boisduval.

P. Nephelus, Bd. Sp. Gén. Lép. p. 210; De Haan, Verh. Nat. Gesch. p. 29, t. 4. f. 4, ♂.

Hab. Malacca, Sumatra, Borneo (♂, ♀) (*Wall.*), Assam (*Brit. Mus.*).

h. *Pammon* group.

62. Papilio Pammon, Linnæus. Tab. II. figs. 1 (♂), 3, 5, 6 (♀ ♀).

♂, *P. Pammon*, L.; Cram. Pap. Ex. t. 141. f. B; Boisd. Sp. Gén. Lép. p. 272.

♀, *P. Polytes*, L.; Cram. Pap. Ex. t. 265. f. A, B, C.

Hab. Malacca, Singapore (*Wall.*), China, India, Ceylon.

The continental specimens of *P. Pammon* have all considerably developed tails in both sexes; the insular specimens on the other hand, (which I treat as a separate species), have only a prominent tooth or very short tail in the males. The females also differ considerably, presenting an analogous but distinct series of forms. In the true *P. Pammon* the males are very constant; but the females exist under three distinct forms, each of them presenting more or less numerous varieties, viz.:—

1*st form* of female. Tab. II. fig. 3.

This exactly resembles the male, except in the possession of a distinct ocellus at the anal angle on the upper surface. Rarely a variety occurs having in addition a submarginal row of red lunules, indicating a slight approximation towards some varieties of the second form.

2*nd form* of female (*P. Polytes*). Tab. II. fig. 5.

This is by far the most common form of female. A variety of this rarely occurs, which

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wants the red patch at the anal angle, and has the white patch formed of a row of spots all situated a little below the discoidal cell. This is the nearest approach to the first form.

3rd form of female (*P. Romulus*, Cram. Pap. Ex. t. 43. f. A; *P. Mutius*, Fab., Bois. Sp. Gén. p. 270; *P. Hector* ♀, De Haan). Tab. II. fig. 6.

This not uncommon Indian butterfly I consider to be a third form of the female of *P. Pammon.* I was first led to suspect this by finding that no males of it are known (the male and female from Ceylon, noted in the British Museum List, I have ascertained to be both females), nor have I been able to find any after an examination of the chief collections in England. It is also to be observed that it has been received from no locality which is not also inhabited by *P. Pammon*; there is no other known Indian butterfly that can possibly be the other sex of it; and lastly, it agrees very closely with the second form of female (*P. Polytes*) in all its details of form, texture, and neuration; and though at first sight having a very different aspect, specimens are to be found which by a very slight modification could be changed so as to resemble that form. I am therefore quite satisfied in my own mind that I am right in sinking this species into a form of *P. Pammon.* I have already stated my opinion that it mimics *P. Hector*, with which, however, it has no affinity. The resemblance was such as to induce De Haan to place it as the female of that species.

63. Papilio Theseus, Cramer. Tab. II. figs. 2, 4, 7 (♀ ♀).

P. Theseus, Cr. Pap. Ex. t. 180. f. B (♀); Boisd. Sp. Gén. Lép. p. 276.
P. Antiphus ♀, De Haan, Verh. Nat. Gesch. p. 49, t. 8. f. 2; Brit. Mus. List. Pap. p. 12.
P. Polyphontes ♀, De Haan, Verh. Nat. Gesch. t. 8. f. 4.
P. Melanides, De Haan, Verh. Nat. Gesch. t. 8. f. 3 (♀).

Male like *P. Pammon* ♂, but smaller, and the tail always reduced to a projecting tooth.

Hab. Java, Sumatra, Borneo, Lombock, Timor (*Wall.*).

Local form *a*. Much larger; more falcate wings; a broad short tail.
Hab. Macassar (*Wall.*)

1st form of female. Tab. II. fig. 2.

Like the male, but with a very slightly marked blue and red ocellus at the anal angle. This is very rare in the islands. I found one specimen only in Timor, which I took "*in copulâ*" with a male almost exactly resembling it.

2nd form of female (*P. Polyphontes* ♀, De Haan). Tab. II. fig. 4.

Like the 2nd form of *P. Pammon* ♀; but has the pale portion of the anterior wing of a much lighter colour, and not extending so far towards the base of the wing; the white spot on the hind wings is more rounded, and has always a rather large portion within the cell. This form is to some extent local, not existing, I believe, in Sumatra, where it is replaced by the next.

Hab. Borneo, Java, Timor (*Wall.*).

3rd form of female (*P. Theseus*, Cr.; *P. Antiphus* ♀, De Haan). Tab. II. fig. 7.

This is well characterized by the entire absence of the white spot from the hind wings.

The red spots and lunules remain; but in some specimens only those in the anal region are visible, and these have a very close resemblance to *P. Antiphus*. This is also a local form, not occurring, I believe, in company with the last.

Hab. Sumatra, Lombock (*Wall.*).

4th form of female (*P. Melanides*, De Haan, Verh. Nat. Gesch. t. 8. f. 3).

I consider this to be an isolated modification of *P. Theseus*, Cr., peculiar to Borneo. It possesses all the characteristics of a female of this species.

Hab. Banjarmassing (Borneo) (*Leyden Museum*).

N.B. The 2nd, 3rd, and 4th forms of ♀ are all tailed, as in the females of *P. Pammon*.

64. PAPILIO ALPHENOR, Cramer.

P. Alphenor, Cr. Pap. Ex. t. 90. f. B (♀); Boisd. Sp. Gén. Lép. p. 274 (♂, ♀); *P. Ledebouria*, Eschsch. Voy. Kotz. t. 3. f. 7.

This is very closely allied to *P. Theseus*. The male is larger, has the caudal tooth scarcely perceptible, and on the under side has white instead of red marginal lunules. The female is tailed, much larger than *P. Theseus* ♀ form 2nd, from which it further differs by the white patch on the hind wings having the red markings blended with it, and more prominent.

Hab. Celebes, Bouru, Amboyna, Ceram (*Wall.*), Philippine Islands.

1st form of female (*P. Ledebouria*, Eschsch.).

Like the male, but with a brown tinge and an obscure anal lunule. This has been noticed only in the Philippine Islands.

2nd form of female (*P. Alphenor*, Cr.).

Distribution the same as the male.

3rd form of female (*P. Elyros*, G. R. Gray, B. M. List Pap. p. 26).

The white patch on the lower wings reduced to a small spot, or quite absent. There are many varieties of this, showing very instructively how such isolated forms of female as occur in the two preceding species may have been produced by simple variation followed by a "natural selection" of the forms best adapted to special conditions.

Hab. Philippine Islands (*B. M.*)

65. PAPILIO NICANOR, Felder, 'Voyage of the Novara,' pl. . . . f. *c*, *d*.

Male. Upper side:—like *P. Alphenor* ♂; but the band of white spots is broader and more regular, and there is a row of four white submarginal lunules.

Under side as in *P. Alphenor*; but the marginal spots of the upper wings, and the submarginal lunules of the lower wings, are larger and more distinct.

Female quite tailless, like the male. Upper side:—like *P. Alphenor* ♀; but the rufous anal spots are much smaller, not forming an ocellus at the anal angle, and they do not join the white central patch.

Under side, differs from *P. Alphenor* in nearly the same manner as on the upper side.

Hab. Batchian, Gilolo, Morty Island (*Wall.*).

Remarks.—The absence of tails in the female, and the white submarginal lunules in the male, distinguish this at a glance from all its allies. It has a comparatively restricted range, and is very constant in both sexes. The plate sent me by Dr. Felder is not numbered.

66. Papilio Hipponous, Felder *.

P. Hipponous, Feld. Lep. Nov. Philipp. p. 12; *P. Dironus*, B. M. List (no description).
Hab. Luzon, Mindanao (Philippines).

67. Papilio Ambrax, Boisduval.

P. Ambrax, Bd. Sp. Gén. Lép. p. 218; Voy. au Pôle Sud, Lép. t. 1. f. 3, 4 (♂); De Haan, Verh. Nat. Gesch. t. 7. f. 2 (♀). *P. Orophanes*, Boisd. Sp. Gén. p. 275 (♀).
Hab. Mysol, Salwatty, Dorey (*Wall.*).

Remark.—I believe that two, if not three, well-marked forms or species have been mixed up under the name of *P. Ambrax*, as I have endeavoured to show by the references. My specimens of the two sexes of each show a uniformity of character in each locality.

68. Papilio Ambracia, Wallace.

P. Ambrax, Bd.; De Haan, Verh. Nat. Gesch. t. 7. f. 1 (♂).

Male. Differs from *P. Ambrax*, Bd., by the ashy-white patch at the apex of the anterior wings.

Female. Has a large, roundish, white patch on the anterior wings, extending from the discoidal cell to the hinder angle. The red lunules on the hind wings are smaller. Same size as *P. Ambrax*.

Hab. Waigiou (♂, ♀) (*Wall.*).

69. Papilio Epirus, n. s.

Male. Above:—anterior wings as in *P. Ambrax*; posterior wings more elongate, the white band much narrower, notched behind at the nervures, with the portions between regularly rounded; the part which crosses the cell is cut by black nervures, and there is an oblique red mark at the anal angle.

Beneath:—with a submarginal of seven lunules on the hinder wings, the one above the anal angle very large; whereas the last two species have one small lunule only beneath, at the anal angle.

Female. Is probably that figured in 'Voy. au Pôle Sud,' Lép. t. 1, f. 5, which resembles most the female of *P. Ambracia*, but differs in the form of the white and red patches. It is said to be from "the coasts of New Guinea"; but as the expedition touched at the Aru Islands, it is very probable that there is an error of locality, as I have ascertained to be very often the case in the indications furnished by these and other 'Voyages.'

Hab. Aru Islands (*Wall.*).

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* Having obtained a specimen of this insect while these sheets are passing through the press, I find that it should have been placed next to *P. Severus*.

70. Papilio Dunali, Montrouzier.

P. Dunali, Mont. Ann. Soc. d'Agricult. de Lyon, 1856, p. 394.
Hab. Woodlark Island (S.E. of New Guinea).

Remark.—This seems closely allied to the last species.

i. *Erectheus* group.

71. Papilio Ormenus, Guérin. Tab. III. figs. 2 (♂), 1, 3, 4 (♀♀).

P. Ormenus, Guér. Voy. de la Coquille, pl. 14. f. 3; Boisd. Sp. Gén. Lép. p. 211.
P. Erectheus, var., Voy. au Pôle Sud, Lép. t. 1. f. 1, 2.
P. Amanga, Boisd. Sp. Gén. p. 216, ♀ (*P. Onesimus*, Hew. Ex. Butt. Pap. iii. f. 8).
Hab. Waigiou, Aru Isl., Ké Isl., Matabello and Goram Isl. (*Wall.*).

This belongs to a remarkable group of Papilios inhabiting the Austro-Malayan region, and which are especially interesting as exhibiting a good instance of polymorphism, the females being of two or three distinct forms.

The male in this species is characterized by the small amount of marking on the under surface.

1*st form* of female. Tab. III. fig. 1.

Almost exactly intermediate between the male and the normal female, which resembles *P. Erectheus* ♀.

Upper side brown-black; a band of four whitish-yellow spots across the anterior wings beyond the cell, the upper one of the same size and position as in the male, the 2nd and 3rd elongated towards the cell, the 4th rather shorter than the 3rd, and immediately beneath it. Posterior wings with a central patch of a pale sulphur-yellow just crossing the end of the cell, and separated below into five truncate lobes; below this, and next the anal margin, are two irregular blue lunules, with a red lunule at the anal angle and a smaller one lower down beneath the second blue lunule.

Under side as above; on the hind wings the upper half of the yellow patch is dusky, and there is a complete submarginal series of seven red lunules.

Hab. Waigiou (a single specimen) (*Wall.*).

2*nd form* of female. Tab. III. fig. 3.

Resembles very closely *P. Erectheus* ♀; but the white patch on the hind wings does not cover so much of the cell, and the two middle lobes are much elongated posteriorly, and separated by wedge-shaped spaces; the blue lunules are but slightly marked, and do not exceed two in number.

Under side:—differs from *P. Erectheus* in the white patch never reaching the anterior margin of the hind wings. In a specimen from Waigiou, the four middle lunules are nearly white. This may be considered the typical form of female, as it occurs everywhere in company with the male.

3*rd form* of female (*Amanga*, Bd.). Tab. III. fig. 4.

I have three specimens of this form from three of the localities in which the male occurs. They differ slightly from each other, but agree generally with the figure and description above quoted. An allied form of female (of the next species) was observed closely followed by two males of the ordinary form; they were watched for some time, the males hovering over the females in the manner usual before pairing; and the three were then captured at one stroke of the net. This occurred three years after the capture of the specimen figured by Mr. Hewitson, and at once convinced me that these puzzling specimens were an additional form of female to a well-known male. The fact that the only females known of an allied species (*P. Tydeus*) are intermediate between these forms confirms this determination.

Hab. **Aru Island, Mysol, Goram Isl.** (*Wall.*)

72. PAPILIO PANDION, n. s.

Male. Closely resembles *P. Ormenus*, but presents the following differences:—

Upper side:—the band of spots across the fore wings is faintly marked, or more frequently quite absent; the grey lines bordering the nervures at the apex are more distinct; on the hind wings, the first three indentations of the whitish patch are followed by faint powdered lunules of the same colour.

Under side:—the apex of the fore wings is strongly marked with grey lines between the nervures, but has generally no spots; on the hind wings there is a curved submarginal band of lunules across the wing, viz., at the anal angle a large irregular red lunulate spot with a blue and a grey mark above it—2nd, a larger grey lunule with an angular blue mark below it, and a red lunule nearer the margin—3rd, a similar grey lunule and blue mark—4th, a larger grey lunule, and a smaller blue mark with a faint red lumule below—5th, a grey lunule and a faint blue dash below—6th, a blue lunule with a faint grey mark above—7th, a blue lunule with a very faint mark above it. These vary somewhat in different specimens, but the whole series can always be traced.

1*st form* of female.

Scarcely distinguishable from the typical female of the last species: the blue lunules on the under surface form a complete series, almost as in *P. Erectheus* ♀.

Hab. **New Guinea, Salwatty, Mysol Island (with the male)** (*Wall.*).

2*nd form* of female.

Upper surface:—fore wings as in *P. Onesimus*, Hew.; hind wings yellowish white, a broad black border along the anterior, and a narrow one along the posterior margin, two yellowish lunules near the outer angle, anal angle pale yellow, then an oblong black spot with a bluish mark in its upper part, followed by a second (half-obliterated) black spot.

Under surface with the same markings; but there are a series of six blue angulated marks upon a black ground, the two intermediate ones being smaller and less distinct. Abdomen yellow; under side black.

Hab. **Dorey (New Guinea)** (*Wall.*)

Remarks.—This specimen was taken in company with two males, as before mentioned. An insect, described by M. Montrouzier as the female of his *P. Godartii* (from Woodlark Island), agrees very closely with this, and is no doubt the female of the same species, or a closely allied one which he puts in his list as *P. Ormenus*. The fact, therefore, that this peculiar pale form of female *Papilio* has been found in five islands, from no one of which is a male insect known which can be mated with it, except those of the *Ormenus*-form (which always occur in the same places), may, in conjunction with the observation already given of the companionship of the two forms, be taken to prove that this is really a case of polymorphism. I believe also it will be found that these extreme departures from the typical form of a species are connected with mimetic resemblances and the safety of the individuals. We have already seen that the extreme forms of *P. Memnon* ♀ and *P. Pammon* ♀ respectively resemble other species which from their habits and abundance seem to have some peculiar immunity from danger. In this case also there is a resemblance to quite a different family of butterflies, the Morphidæ. In form, coloration, and general appearance these pale-coloured Papilios resemble species of the genus *Drusilla*; and the same genus is also imitated by other butterflies—one of these, *Melanitis Agondas* ♀, having been actually confounded with *Drusilla bioculata* as the same species, so great is the resemblance. This fact of species of several genera imitating the Drusillas would indicate that they have some special immunities which make it advantageous to other insects to be mistaken for them; and their habits confirm this opinion. They have all a very similar style of dress, and fly very slowly, low down in damp woods, often settling on the ground or on rotten wood; and they are exceedingly abundant in individuals. Now these are the general characteristics of all groups which are the subjects of imitation; and we may therefore presume, when we see forms departing widely from the general appearance of their close relations, and resembling closely other groups with which they have no affinity, that what we must call *accidental* variations have been accumulated and rendered definite by natural selection for the protection and benefit of those forms.

73. PAPILIO TYDEUS, Felder. Tab. IV. figs. 3 (♂), 2 (♀).

P. Tydeus, Feld. Lep. Fragm. p. 52 (♂).

Female.—Upper side dusky brown; fore wings with the central portion below the cell nearly white; hind wings with the basal two-thirds white, with an irregular and obtusely dentated margin, and edged with ochre-yellow; the rest black, with a submarginal row of seven broad yellowish lunules, and above those nearest the anal angle three irregular blue patches.

Under side nearly as above; the white space on the upper wings is more extensive and better defined; the marginal lunules are dilated so as to form a crenellated band, and the blue marks are increased to six or seven in number. Head and thorax dusky; abdomen yellowish.

Hab. Batchian, Morty Island (*Wall.*).

Remark.—The female, which seems to be of only one form in this species, is especially interesting as being allied to the pale-yellow form of *P. Ormenus* and *P. Pandion.*

74. PAPILIO ADRASTUS, n. s. Tab. IV. fig. 1 (♀).

Male.—Upper side, like *P. Ormenus* ♂; but has the band of the hind wings narrower, not crossing the cell, and more pointed towards the anal angle.

Under side with a single red anal spot, and three blue lunules beyond it.

Female.—Upper side brown black; anterior wings with the apical half browner, a whitish patch around the end of the cell, and an ovate spot within it; posterior wings with a small central whitish patch more or less tinged with ochreous; a submarginal row of very large deep-red lunules, that at the anal angle forming an irregular ocellus bordered above with pale blue, and a few blue atoms on the side of it. Indentations of all the wings broadly margined with ochreous.

Under side:—the white patch of the anterior wings larger and well defined, and continued by smaller and fainter patches to the outer angle; posterior wings with the small central patch and marginal lunules as above, with the addition of a faint row of angulated blue marks between them.

Wings elongated posteriorly, and somewhat angulated at the termination of the first median nervure.

Expanse of wings, ♂, 5¼ inches; ♀, 6 inches.

Hab. Banda Island (*Wall.*).

Remarks.—This species is near *P. Ormenus* in the male, but approaches *P. Gambrisius* in the female, which differs from all others in this group by its dark colouring and the short narrow band on the hind wings. A male and two females were obtained in the small island of Banda.

75. Papilio Gambrisius, Cramer.

P. Gambrisius, Cr. Pap. Ex. t. 157. f. A, B (♂); Boisd. Sp. Gén. Lép. p. 213.
P. Drusius, Cr. Pap. Ex. t. 229. f. A, t. 230. f. A (♀); Boisd. Sp. Gén. Lép. p. 218.
Hab. Amboyna, Ceram, Bouru (*Wall.*).

Remarks.—The males of this fine species are not uncommon in Ceram, and in hot weather come down to the beach and settle on the wet sand. The females, however, are very rare; I obtained one in the mountainous forests of Ceram, and this is, I believe, the only fine and perfect specimen now in Europe.

Expanse of male 5½–6½ inches, of female 7 inches.

76. Papilio Amphitrion, Cramer.

P. Amphitrion, Cr. Pap. Ex. t. 7. f. A, B; Boisd. Sp. Gén. Lép. p. 217.
Hab. Celebes?

Remarks.—The habitat of this rare species is doubtful. Cramer says, "America;" Godart, "Amboyna;" but I believe its true locality will be found to be Celebes. It forms a transition to the next species.

77. Papilio Euchenor, Guérin.

P. Euchenor, Guér. Voy. de la Coquille, t. 13. f. 3 (♂); *P. Axion*, Boisd. Sp. Gén. Lép. p. 46 (♂).

Female.—Similar to the male; but the markings are all of a dull ochre-yellow, and the second and third spots, reckoning from the inner margin of the upper wings, are almost entirely wanting. This sex is much rarer than the male.

Hab. New Guinea, Aru Island, Ké Island (*Wall.*).

78. **Papilio Godartii**, Montrouzier.

P. Godartii, Montr. Ann. Soc. d'Agric. de Lyon, 1856, p. 394.
Hab. Woodlark Island.

Remark.—Closely allied to the last; perhaps a variation only.

k. *Demolion* group.

79. **Papilio Demolion**, Cramer.

P. Demolion, Cr. Pap. Ex. t. 89. f. A, B; *P. Cresphontes*, Fabr.; Boisd. Sp. Gén. Lép. p. 220.
Hab. Java, Borneo, Sumatra, Singapore (*Wall.*), Moulmein (*Brit. Mus.*).

80. **Papilio Gigon**, n. s. Tab. VII. fig. 6 (♀).

"*P. Gigon*," List of Papilionidæ in Brit. Mus. p. 27 (no description).

Much larger than *P. Demolion*; costal margin of the fore wings very much arched from the base; tail proportionally shorter.

Upper side:—markings as in *P. Demolion*, with the following differences. In the cell of the fore wings are four longitudinal curved greyish-yellow lines; the yellow band begins higher on the abdominal margin, and curves outward toward the tip, where the spots are obliquely elongate, and the three last distinctly notched; on the hind wings the lunulate spots are much deeper and are rather further from the margin, and the two spots at the outer angle (often obsolete in *P. Demolion*) are large and well marked.

Under side:—the markings resemble those of *P. Demolion*, but are stronger; the band of silvery spots is much more sinuate, and possesses an additional lunule above the outer angle; a patch of ochre-yellow covers the lower margin of the cell, extending a little along the nervures which radiate from it.

Abdomen blackish, with numerous stripes and spots of pale yellow.

Expanse of wings $4\frac{3}{4}$ to $5\frac{1}{3}$ inches.

Hab. Celebes, Sulla Island (*Wall.*).

Remark.—This was regarded by Boisduval as a large variety of *P. Demolion* (see Sp. Gén. Lép. p. 221); but it offers remarkable differences both in form and markings.

l. *Erithonius* group.

81. **Papilio Erithonius**, Cramer.

P. Erithonius, Cr. Pap. Ex. t. 232. f. A, B.
P. Epius, Fabr.; Don. Ins. China, pl. 29. f. 2; Boisd. Sp. Gén. Lép. p. 238.
Hab. India, China (*type*).

Local form *a* (*Malayanus*).—The two spots on the lower margin of the cell of the hind wings wanting; anal spots redder, and the ocellus at the outer angle darker: two spots in cell of fore wings, as in the type; but in Flores specimens these approach so as almost to unite.

Hab. Singapore, Flores (*Wall.*), Manilla.

Local form *b* (*Sthenelus*, Macleay).—A single large spot in the cell of the fore wings; one small detached spot on the margin of the cell of the hind wings.

Hab. Goram Island (*Wall.*), Australia.

SECTION C.

m. *Paradoxa* group.

82. PAPILIO PARADOXA, Zinken.

Zelima Paradoxa, Zink. Beitr. Ins. Java, t. 15. f. 9, 10.
P. Paradoxa, Westw. Cab. Or. Ent. pl. 9. f. 1, 1*.
Hab. Java (*Wall.*).

Local form *a.*—*P. Paradoxa*, var., Hew. Proc. Zool. Soc. 1859, p. 422, pl. 67. f. 1 (♂), 2 (♀).

Hab. Borneo (*Wall.*).

Local form *b.*—Smaller; intermediate in the markings between the Java and Borneo forms; interior row of elongate marks on upper wings light blue, not descending to the outer angle.

Hab. Sumatra (*Wall.*).

Both sexes of this species closely resemble the corresponding sexes of *Euplœa Midamus*, Cr., which is very common in all the above-mentioned localities.

83. PAPILIO ÆNIGMA, n. s. Tab. VII. fig. 3 (♂).

Size, form, and markings nearly the same as in *P. Paradoxa*.

Above:—purplish black, without any gloss or silky reflexions; a submarginal row of white spots on all the wings, more or less blue-edged on the upper wings, sometimes partially obsolete on the lower ones; one or two spots at the end of the cell, and a row of six or seven elongate marks beyond it, bright blue.

Beneath, the submarginal row of white spots only.

Female.—*P. Paradoxa*, var. A, Hewitson, Proc. Zool. Soc. 1859, p. 423, pl. 67. f. 3.

I put this as the female of the above with some hesitation, as it was not captured in the same island. It agrees, however, in the entire absence of gloss, and in the peculiar elongation of the outer angle of the lower wings.

Hab. Malacca, Sumatra (♂); Borneo (♀) (*Wall.*).

Female variety?—*P. Paradoxa*, var. B, Hewitson (Proc. Zool. Soc. pl. 66. f. 4), may be an extreme variation of this, but will more probably, when the male is discovered, prove to be a distinct species.

84. PAPILIO CAUNUS, Westwood.

P. Caunus, Wesw. Cab. Or. Ent. pl. 9. f. 2, 2*.
Hab. Sumatra, Borneo (♂, ♀) (*Wall.*), Java (*Leyden Mus.*).

Remarks.—My specimens have less white on the lower wings than is represented in Mr. Westwood's figure. The female is of a brownish colour, with the same white markings as the male, but without any blue tinge. This species is very like *Euplœa Rhadamanthus,* one of the most common butterflies in all the above-mentioned localities. It is undistinguishable from that insect on the wing, though it flies very slowly, like the species it mimics.

85. PAPILIO ASTINA, Westwood.

P. Astina, Westw. Cab. Or. Ent. pl. 9. f. 3.
Hab. Java (*Brit. Mus. ex Coll. Horsf.*).

86. PAPILIO HEWITSONII, Westwood.

P. Hewitsonii, Westw. Proc. Ent. Soc. 1864, p. 10.
P. Slateri ♀, Hew. Ex. Butt. Pap. pl. 4. f. 9; *P. Camma,* B. M. List of Papilionidæ (no description).
Hab. Borneo (♂) (*Wall.*).

Remarks.—The last two species should probably form a distinct group, on account of the peculiar elongation of the cell of the lower wings. They both resemble dark species of *Euplœa. P. Slateri* is a quite distinct species from North India, to which Mr. Hewitson referred the present species as the female. All the specimens known of both species are, however, males.

n. *Dissimilis* group.

87. PAPILIO ECHIDNA, De Haan.

P. Echidna, De Haan, Verh. Nat. Gesch. p. 42, t. 8. f. 6; *Clytia dissimilis,* Sw. Zool. Ill. 2nd ser. pl. 120; *P. dissimilis,* var., Brit. Mus. List of Papilionidæ.
Hab. Timor (♂, ♀) (*Wall.*).

Remarks.—This species has been confounded with *P. dissimilis,* from which it is very distinct, by the absence of the yellow marginal band beneath. It is also widely separated geographically from that species, which inhabits the continent of India only. The sexes are alike, as they are in *P. dissimilis. P. Panope,* L., which has been supposed to be its female, is a very distinct species, of which also both sexes exist in most collections.

88. PAPILIO PALEPHATES, Westwood.

P. Palephates, Westw. Arc. Ent. pl. 79. f. 1; *P. dissimilis,* var. *b,* Brit. Mus. List of Papilionidæ.
Hab. Philippine Islands.

SECTION D.

o. *Macareus* group.

89. PAPILIO VEIOVIS, Hewitson.

P. Veiovis, Hew. Ex. Butt. Pap. pl. 7. f. 20 (♂).
Hab. Menado (Celebes) ("*Coll. Hewitson.*").

Remark.—This fine new species has been recently received from Menado, and seems best placed in this group, near *P. Encelades.*

90. Papilio Encelades, Boisduval.

P. Encelades, Bd. Sp. Gén. Lép. p. 376; Hewitson, Ex. Butt. Pap. pl. 4. f. 10 (♂).
Hab. Macassar (Celebes) (*Wall.*).

91. Papilio Deucalion, Boisduval.

P. Deucalion, Bd. Sp. Gén. Lép. p. 375; Hewitson, Ex. Butt. Pap. pl. 4. f. 11 (♀).
Hab. Macassar, Menado (Celebes) (*Wall.*).

Remarks.—At Macassar I took only males of *P. Encelades,* and females of *P. Deucalion* at the same spot (a half-dry river-bed), and therefore conjectured that they might be sexes of one species, although so unlike. Some years afterwards, however, I took at Menado a fine male of *P. Deucalion,* which only differs in its rather smaller size and brighter colouring.

92. Papilio Idæoides, Hewitson.

P. Idæoides, Hew. Ex. Butt. Pap. pl. 1. f. 2.
Hab. Philippine Islands (♂) (*Brit. Mus.*).

Remark.—This singular species must closely resemble on the wing *Hestia Leuconoë,* from the same islands.

93. Papilio Delessertii, Guérin.

P. Delessertii, Guér.; Deless. Souvenirs, t. 17.
Hab. Pulo Penang (*Hope Museum, Oxford*).

Remark.—This resembles the species of *Hestia* and *Idæopsis,* from the same locality, and is intermediate in size. It has been confounded with the next.

94. Papilio Dehaanii, Wallace.

P. Laodocus, De Haan, Verh. Nat. Gesch. t. 8. f. 5 (nec Fab.); *P. Melanides,* Erichs. Archiv für Natur. 1843 (nec De Haan, 1839).
Hab. Malacca, Borneo (*Wall.*), Java (*Leyden Mus.*).

Remarks.—The Bornean specimens are rather larger, and have the yellow anal spot somewhat differently shaped. The two names which have been applied to this species having been preoccupied, I have named it after the first describer.

95. Papilio Leucothoë, Westwood.

P. Leucothoë, Westw. Arc. Ent. pl. 79. f. 3; *P. Xenocles,* var., Brit. Mus. List of Pap.
Hab. Singapore, Malacca (*Wall.*), N. India.

96. Papilio Macareus, Godart.

P. Macareus, Godt. Enc. Méth. ix. pl. 76; Horsf. Desc. Cat. Lep. E. I. C. pl. 5. f. 1; Boisd. Sp. Gén. Lép. p. 374.
P. striatus, Zink. Beitr. Ins. Java, t. 14. f. 5.
Hab. Malacca (*Wall.*), Java (*Horsfield*), Borneo (*Leyden Mus.*).

This species closely resembles *Danaïs Aglaë,* Cr., found in the same islands.

97. Papilio Stratocles, Felder.

P. Stratocles, Feld. Lép. Nov. Philipp. p. 2.
Hab. Mindanao (Philippines).

98. Papilio Thule, n. s. Tab. VII. fig. 1 (♂).

Form of *P. Macareus*, but smaller.

Above :—brown-black, spotted and marked with greenish white; a row of spots near the outer margin of all the wings, and on the upper wings a second row between the first and the end of the cell, three or four others close to the cell, and 5–7 irregularly placed in the cell; the spot next the outer angle is double, and the two lower spots of the second row are continued indistinctly to the cell. The lower wings have a mark at the end of the cell, and five elongated spots radiating from it between the nervures.

Beneath :—brown, with the spots all whiter and more distinct. Neck with four white points; abdomen dusky, with pale lines on the sides and beneath.

Expanse of wings 3¾ inches.

Hab. New Guinea (♂) (*Wall.*).

Variety or local form *a.*—Like the above, but with the discal spots of the lower wings united into a transverse band divided by fine nervures.

Hab. Waigiou Island (♂) (*Wall.*).

This species imitates *Danaïs sobrina*, Bd., a New Guinea species. The figure represents the upper surface of both forms of this insect.

p. *Antiphates* group.

99. Papilio Antiphates, Cramer.

P. Antiphates, Cr. Pap. Ex. t. 72, f. A, B; Boisd. Sp. Gén. Lép. p. 248.
P. Pompilius, Fab.; Lucas, Lep. Ex. t. 22. f. 1; Godt. Enc. Méthod. ix. p. 49.
P. Alcibiades, Fab.; Godt. Enc. Méthod. ix. p. 49.
Hab. India, China (“*type*”).

Local form *a.*—*Podalirius Pompilius*, Sw. Zool. Ill. 2nd ser. pl. 105.

Hab. Malacca, Sumatra, Java, Borneo (*Wall.*).

These differ from the type in the black apical portion not quite reaching the outer angle, and in the first and second bands on the upper wings not extending below the cell. The fourth band varies in extent, as does the amount of grey colouring in the caudal region.

100. Papilio Euphrates, Felder.

P. Euphrates, Feld. Lep. Nov. Philipp. p. 12; *P. Coretes,* Brit. Mus. List of Papilionidæ (no description).
Hab. Philippine Islands.

101. Papilio Androcles, Boisduval. Tab. VII. fig. 5 (♂).

P. Androcles, Bd. Sp. Gén. Lép. p. 279.
Hab. Macassar (Celebes) (*Wall.*).

Remarks.—I only met with this magnificent species on one occasion, on the bank of a mountain-stream and on the sands close to a waterfall. When resting on th ground, the very long white tails are raised up at a considerable angle, and are ver conspicuous.

102. PAPILIO DORCUS, De Haan.

P. Dorcus, De Haan, Verh. Nat. Gesch. Zool. t. 7. f. 4.
Hab. Gorontalo (N. Celebes) ("*Leyden Museum*").

103. PAPILIO RHESUS, Boisduval.

P. Rhesus, Bd. Sp. Gén. Lép. p. 253.
Hab. Macassar (Celebes) (*Wall.*). "Bengal," the locality given by Boisduval, is erroneous.

104. PAPILIO ARISTÆUS, Cramer.

P. Aristæus, Cr. Pap. Ex. t. 318, f. E, F; Boisd. Sp. Gén. Lép. p. 252.
Hab. Ceram, Batchian (*Wall.*).

105. PAPILIO PARMATUS, G. R. Gray.

P. Parmatus, G. R. Gray, Cat. Lep. Ins. Brit. Mus. pl. 3. f. 2.
Hab. Aru Islands, Waigiou (*Wall.*), Australia (*Brit. Mus.*).

Remarks.—The Aru specimen agrees almost exactly with the type specimen in the British Museum. The Waigiou insect is rather darker on the under surface, and has the black markings more sharply defined.

q. *Eurypylus* group.

106. PAPILIO CODRUS, Cramer.

P. Codrus, Cr. Pap. Ex. t. 179. f. A, B; Boisd. Sp. Gén. Lép. p. 228.
Hab. Amboyna and Ceram (*type*) (♂, ♀) (*Wall.*).

Local form *a* (*Gilolensis*).—Differs from the true *P. Codrus* in having always an additional semiovate spot below the submedian nervure, and in having a small round spot on the anterior margin of the lower wings beneath: it is also rather smaller.

Hab. Batchian and Gilolo (*Wall.*)

Subspecies *b* (*Celebensis*).—Fore wings in the male more attenuate, with the costal margin more curved than in true *P. Codrus*; upper surface more green and glossy; an additional large quadrate spot on the inner margin of the fore wings. Under surface lighter brown, the whitish marks near the anal angle wanting; a dark subtriangular band across the cell of the fore wings. Rather smaller than *P. Codrus.*

Hab. Celebes, Sulla Islands (*Wall.*).

Subspecies *c* (*Papuensis*).—Hind wings less elongate than in the true *P. Codrus*; macular band much broader, and reaching the inner margin of the upper wings, the lower portion divided by nervures only; the band continued on the lower wings by means of an obscure white fascia.

Beneath, the greenish white band continues on to the lower wings, but gradually fades away after reaching the cell. Expanse of wings 4¼ inches.

Hab. Waigiou, Aru Island (*Wall.*).

Remarks.—This approaches the next species. Subspecies *b* and *c* I consider to be really as distinct as many universally received species, differing in form and in several points of coloration. As, however, it is probable that there are forms in other islands which may present intermediate characters, I prefer retaining the whole under the old specific name.

107. PAPILIO MELANTHUS, Felder.

P. Melanthus, Feld. Lep. Nov. Philipp. p. 12.

Hab. Mindanao (Philippines).

108. PAPILIO EMPEDOCLES, Fabricius.

P. Empedocles, Fab. Ent. Syst. iii. 1. p. 70; Don. Ins. Ind. pl. 17. f. 1; Boisd. Sp. Gén. Lép. p. 229.

Hab. Borneo (*Wall.*).

109. PAPILIO PAYENI, Boisduval.

P. Payeni, Bd. Sp. Gén. Lép. p. 235; Van der Hoeven, Tijd. von Nat. Gesch. v. t. 8, f. 1, 2, 6.

Hab. Borneo (*Wall.*), Java (*Van der Hoeven*).

Remarks.—This remarkable species has been placed by Boisduval in a group by itself. It, however, agrees very closely in habits and structure with this group, and can hardly, I think, be separated, though very abnormal in colouring. *P. Evan*, Db., is a closely allied species from India; and *P. Gyas*, Westw., from the same country, is also nearly related, though it has been hitherto placed in another section of the genus.

110. PAPILIO SARPEDON, Linnæus.

P. Sarpedon, L.; Cram. Pap. Ex. t. 122. f. D, E.; Boisd. Sp. Gén. Lép. p. 235.

Chlorisses Sarpedon, Sw., Zool. Ill. 2nd ser. pl. 89.

Hab. Borneo, Sumatra (typical), New Guinea, Aru Is. (darker), Java (broader band) (*Wall.*).

Local form *a* (*Moluccensis,* Cram. Pap. Ex. t. 122. f. D, E).—Black, with the bands and spots rich blue.

Hab. Ceram, Batchian, Gilolo, Bouru (*Wall.*). (The Ceylon form closely resembles this.)

111. PAPILIO MILETUS, n. s. Tab. VII. fig. 2 (♂).

Wings larger and more falcate than in *P. Sarpedon,* costal margin abruptly curved near the base of the wing.

Above, black; macular band rich blue, very narrow, the spots on the upper wings all more or less rounded and separated by thick black bands; the marginal lunules large and angularly bent.

Beneath, the upper wings have a row of four pearly-white lunules from the outer angle; and there is one of the same colour at the outer angle of the lower wings, which have also an additional red spot on the margin of the cell, below the first branch of the subcostal nervure. Expanse of wings 4¾ inches.

Hab. Macassar and Menado (Celebes) (*Wall.*).

Remarks.—I have separated this species from all the other forms of *P. Sarpedon*, because, while they differ in markings and colour only, this differs greatly in form as well as very strikingly in size, colour, and markings. I cannot conceive, therefore, why such a combination of distinctive peculiarities should not entitle it to specific rank.

112. Papilio Wallacei, Hewitson.

P. Wallacei, Hew. Ex. Butt., "Papilio," iii. f. 7.
Hab. Aru Islands, Batchian (*Wall.*).

Remark.—This isolated species is very rare: I obtained a single male specimen in each of the above localities in the virgin forest.

113. Papilio Bathycles, Zinken.

P. Bathycles, Zink. Beitr. Ins. Java, p. 157, tab. 14. f. 6, 7; Boisd. Sp. Gén. Lép. p. 232.
Hab. Java, Borneo, Malacca (*Wall.*).

Remark.—The Indian form generally confounded with this I consider to be a very distinct species, for which I propose the name of *P. Chiron*, and add a description below*.

114. Papilio Eurypylus, Linnæus.

P. Eurypylus, L.; Cram. Pap. Ex. t. 122. f. C, D; Boisd. Sp. Gén. Lép. p. 233.
Hab. Amboyna (type), Ceram, Bouru, Batchian, New Guinea (*Wall.*).

Remark.—The *male* has the abdomen above and abdominal margin white; the *female* blackish.

115. Papilio Jason, Esper.

P. Jason, Esp. Ausl. Schmett. t. 58. f. 5; *P. Jason*, L.? *P. Eurypylus*, var., Boisd. Sp. Gén. Lép. p. 233.
Hab. Malacca, Sumatra, Borneo (♂, ♀) (*Wall.*).

Remarks.—This species is readily distinguished from *P. Eurypylus* by the abdomen above, and the abdominal margin, being black in both sexes, by the smaller size, more pointed upper wings, and by the lower wings having a narrower band and larger spots of a deeper green colour. On the under surface the marginal lunules, the cell-spots, and sub-basal stripe are all larger.

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* Papilio Chiron, n. s.

P. Bathycles (partly), Brit. Mus. List of Papilionidæ.

Very near *P. Bathycles*, Zinken. Fore wings rather broader at the tip; hind wings considerably less elongate posteriorly.

Above:—fore wings have the three larger green spots separated by broad black spaces, the first produced towards the base of the wing, the second notched above; the fourth spot in the cell much more linear. Hind wings have the green markings more elongate and narrower, and an additional narrow mark at the abdominal margin.

Beneath, the spots all separated by broad black lines; the abdominal stripe, which is quite wanting in *P. Bathycles*, larger than above; an ochre-yellow spot on the hind wings, near the base of the inner margin (absent in *P. Bathycles*): the submarginal pale spots larger, and the row of reddish-ochre spots less developed. Expanse of wings 3⅓ inches.

Hab. Assam, Sylhet.

Variety or dimorphic form *a.*—*Evemon*, Bois. Sp. Gén. Lép. p. 234.

Hab. Malacca, Java, Sumatra, Borneo (♂, ♀). (*Wall.*)

This may be a distinct species, but is more probably a case of dimorphism. The two forms are absolutely identical, except that the red spot at the base of the lower wings beneath, in *P. Jason*, is constantly absent in *P. Evemon.*

116. PAPILIO TELEPHUS, n. s. Tab. VII. fig. 4 (♂).

Larger than *P. Eurypylus*; anterior wings more elongated, with their costal margin abruptly curved near the base.

Above, the four spots in the cell of the upper wings linear, of equal width, not increasing in thickness from the base outwards, as in *P. Eurypylus*; the macular band narrower, nearly white on the lower wings; abdomen and abdominal margin pure white.

Beneath, the red anal spot is not produced upwards along the abdominal margin, the pearly spots have a distinct dusky border, owing to their exceeding in size those on the upper surface. Expanse of wings 4¼ inches.

Hab. Celebes (*Wall.*).

Remarks.—This is a powerful species of very rapid flight, and difficult to capture. It comes about muddy places in the villages of South Celebes, and is also found abundantly at pools in the half-dry mountain-streams. I consider it quite distinct from all the allied forms.

117. PAPILIO ÆGISTUS, Linnæus.

P. Ægistus, L.; Cram. Pap. Ex. t. 241. f. C, D; Boisd. Sp. Gén. Lép. p. 231.

Hab. Ceram, Gilolo, Batchian, Aru Islands (*Wall.*)

118. PAPILIO AGAMEMNON, Linnæus.

P. Agamemnon, L.; Cram. Pap. Ex. t. 106. f. C, D; Boisd. Sp. Gén. Lép. p. 230.

This species presents numerous slight modifications of form and marking, which seem hardly prominent enough to characterize as species, though tolerably constant in each locality. Type tailed.

Hab. India, Manilla.

Local form *a.* Tail shorter; wings rather pointed.

Hab. Timor, Flores (*Wall.*).

Local form *b.* Tail as in the last; two outer rows of spots on the lower wings absent.

Hab. Ké Island (*Wall.*).

Local form *c.* Size small; tail very short.

Hab. Malacca, Sumatra, Borneo, Java (*Wall.*).

Local form *d.* Wings much elongated, abruptly curved near the base; tail very short; size large.

Hab. Celebes (*Wall.*).

Local form *e*. Broader and less sinuated wings, body large, tail very short.

Hab. Ceram, Bouru, Batchian (*Wall.*).

Local form *f*. Form of *c*; tail reduced to a tooth; markings and spots well defined, rounded.

Hab. New Guinea, Aru Islands, Waigiou (*Wall.*).

119. PAPILIO RAMA, Felder.

P. Rama, Feld. Lep. Nov. Mal. p. 1. *P. Arycles,* Boisd. Sp. Gén. Lép. p. 231?

Hab. Malacca, Sumatra (*Wall.*).

Remarks.—I have little doubt but this is the *P. Arycles* of Boisduval. His description, however, does not mention the distinctive character of the four large spots only in the discoidal cell; I have therefore used Dr. Felder's name.

LEPTOCIRCUS, Swainson.

This small but interesting genus differs somewhat from *Papilio* in the neuration of the wings, but is best distinguished by the longitudinal fold and great elongation of the hind wings. The species frequent water, often settling on the edges of rills, or hovering over pools and rivulets in the sunshine. The few species known are all very closely allied, and might with equal propriety have been considered as local forms of one species. Three have been already described, and I have therefore thought it better to add one more, than to attempt to reduce those which have been generally accepted as species to a lower rank.

120. LEPTOCIRCUS MEGES, Zinken.

P. Meges, Zink. Beitr. Ins. Java, p. 161, tab. 15. f. 8. *Leptocircus Curius,* Sw. Zool. Ill. pl. 106; Boisd. Sp. Gén. pl. 7. f. 1, pl. 17. f. 3, p. 381.

Hab. Java, Malacca (*Wall.*).

121. LEPTOCIRCUS CURTIUS, n. s.

Larger than *L. Meges*; outer black margin broader, and apical nervures thicker; bluish band much narrower, of equal width on both wings, straight, abruptly narrow where it crosses the discoidal cell of the fore wings, and rounded at the inner margin so as to form a small notch at the junction of the fore and hind wings.

Under side with the band bluish silvery; the three small bands on the anal margin differing from those on *L. Curius* and *L. Meges*, the first being transverse, and not produced obliquely to join the vertical band, the second small and nearly obsolete, the third at the anal angle transverse, very little curved, and sharply defined.

Body beneath and base of all the wings greenish ashy. Expanse of wings $1\frac{9}{10}$–2 inches. Length, head to tip of tail $2\frac{6}{10}$ inches.

Hab. Celebes (*Wall.*).

122. LEPTOCIRCUS DECIUS, Felder.

L. Decius, Feld. Lep. Nov. Philipp. p. 13. *L. Corion*, G. R. Gray, List of Pap. in Brit. Mus.

Hab. Philippine Islands.

123. Leptocircus Curius, Fabricius.

L. Curius, Fab. Ent. Syst. iii. 1. p. 28; Doubleday, Zoologist, 1843, p. 111; Gen. of Diurnal Lep. pl. 4*. f. 1; Don. Ins. Ind. pl. 47. f. 1.

Hab. Java (*Wall.*), North India.

Note.

In referring to the species described by Dr. Felder, I have quoted from papers which he has sent me, with distinct titles and separate paging, but which were all first published in the 'Wiener Entomologischen Monatschrift,' viz. "Lepidopterologische Fragmente" (quoted as "Lep. Fragm."), published at intervals from June 1859 to August 1860, "Lepidoptera Nova Malayica" (quoted as "Lep. Nov. Mal."), published in 1860, and "Lepidoptera Nova a Dr. Carolo Semper in insulis Philippinis collecta" (quoted as "Lep. Nov. Philipp."), published in 1861. It is to be regretted that the titles and paging of these separate papers were not made to correspond with the original publication, so as to have made a more exact reference possible.

I have also quoted Zinken's 'Beitrag zur Insecten-Fauna von Java' separated from the 'Nova Acta Acad. Nat. Curios.'; but in this case the pages and the numbering of the plates have been preserved as in the original work.

EXPLANATION OF THE PLATES.

Plate I.

Represents the various forms of *Papilio Memnon* (see pages 6 and 46). N.B. The left side of each figure shows the upper surface, and the right side the under surface of the same insect.

Fig. 1. A male, from Borneo (a slight local variety).

Fig. 2. A female, from Java (a variety like *P. Agenor*, Cr.).

Fig. 3. A female, from Sumatra (a variety near *P. Anceus*, Cr.). The last two are varieties of the 1st dimorphic form of female in this species.

Fig. 4. A female, from Java (*P. Achates*, Cr.). The 2nd dimorphic form of female of *Papilio Memnon*.

Plate II.

Represents the various forms of *Papilio Pammon* (figs. 1, 3, 5, and 6) and *P. Theseus* (figs. 2, 4, and 7). (See pages 6, 7, 51, 52, and 53.) N.B. The left side of each figure shows the upper surface, and the right side the under surface of the same insect.

Fig. 1. *Papilio Pammon*; a male, from Malacca.

Fig. 3. The first form of female, closely resembling the male, from India.

Fig. 5. The second form of female (*P. Polytes*, L.), from Singapore. This is the most common and widely distributed form of female, occurring everywhere with the male.

Fig. 6. The third form of female (*P. Romulus*, Cr.), from India.

Fig. 2. *Papilio Theseus,* the first form of female, almost exactly resembling the male, from Timor. This form is very rare.

Fig. 4. The second form of female, from Timor.

Fig. 7. The third form of female (*P. Theseus,* Cr.), from Sumatra. The second and third forms of female seem about equally plentiful, but are generally confined to separate islands. A fourth form of female (*P. Melanides,* De Haan) would have been figured, but could not be brought on to the plate. (See pages 7 and 53.)

PLATE III.

Represents the various forms of *Papilio Ormenus* (see pages 8, 55, and 56). N.B. The left side of each figure shows the upper surface, and the right side the under surface of the same insect.

Fig. 2. A male, from the island of Goram.

Fig. 1. The first form of female, from Waigiou.

Fig. 3. The second form of female, from Waigiou.

Fig. 4. The third form of female (*P. Amanga,* Bd.), from the island of Goram.

PLATE IV.

Represents two species allied to *Papilio Ormenus,* but whose females are not *dimorphic* (see pages 57 and 58). N.B. The left side of each figure shows the upper surface, and the right side the under surface of the same insect.

Fig. 1. A female of *Papilio Adrastus,* peculiar to the island of Banda (see page 57).

Fig. 3. *Papilio Tydeus*; a male, from Batchian.

Fig. 2. The female of *Papilio Tydeus,* exhibiting a single permanent form confined to a small group of islands (Batchian and Gilolo), intermediate between the two forms of *Papilio Ormenus* ♀ which are represented on Plate III. figs. 3 and 4.

PLATE V.

Represents several new species of *Papilio,* illustrating "local variation." N.B. The right side of each figure shows the upper surface, and the left side the under surface of the same insect.

Fig. 1. The male of *Papilio Noctis,* from Borneo (see page 41). The female was figured by Mr. Hewitson in the 'Proceedings of the Zoological Society of London,' 1859, plate 66. fig. 5.

Fig. 2. *Papilio Leodamas,* male, from Mysol (see page 42).

Fig. 3. *Papilio Hecuba,* male, from Celebes (see pages 16 and 50).

Fig. 4. *Papilo Pertinax,* male, from Celebes (see page 49).

Fig. 5. *Papilio Albinus,* male, from New Guinea (see page 49).

PLATE VI.

Represents four species not before figured, belonging to the most brilliantly coloured group of Easterr Papilios, and illustrating local modifications of form. N.B. The right side shows the upper surface, and the left side the under surface of the same insect.

Fig. 1. *Papilio Pericles,* male, from Timor (see page 45).

Fig. 2. *Papilio Macedon,* male, from Celebes (see page 45). This species exhibits in a marked manner the strongly arched wings characteristic of those from Celebes, as contrasted with those represented at figs. 1 and 3, from other islands (see pages 16, 17 and 18).

Fig. 3. *Papilio Philippus,* female, from Ceram (see page 45).

Fig. 4. *Papilio Blumei,* male, from the north of Celebes (see page 46). This also exhibits the arched wing, as compared with its ally from the Moluccas (fig. 3).

PLATE VII.

Represents six remarkable species of *Papilio* not before figured. N.B. Except in fig. 1, the right side shows the upper surface, and the left side the under surface of the same insect.

Fig. 1. *Papilio Thule*, male. The upper surfaces of two varieties or local forms of this species are figured. The right side represents the form found in New Guinea, the left side that obtained in Waigiou. It resembles *Danais sobrina*, Bd., which inhabits the same countries, and varies in a somewhat similar manner (see pages 20 and 63).

Fig. 3. *Papilio Ænigma*, male, from Sumatra (see page 60). This species was named as above, from its puzzling resemblance to *Papilio Paradoxa*, which is found in the same districts. Both species appear to mimic *Euplœa Midamus* (see page 20).

Fig. 2. *Papilio Miletus*, male, from Celebes (see page 65). This species and the next exhibit in a striking manner the abruptly curved wing peculiar to Celebes. Figs. 5 and 6 represent species almost equally remarkable in this respect.

Fig. 4. *Papilio Telephus*, male, from Celebes (see page 67).

Fig. 5. *Papilio Androcles*, male, from Celebes (see page 63).

Fig. 6. *Papilio Gigon*, female, from Celebes (see page 59).

PLATE VIII.

Illustrates, by comparative outlines of the anterior wings, the local modification of form in the Papilios of Celebes as compared with those of the surrounding islands. In each pair of outlines, the upper one represents a species peculiar to Celebes, while the one beneath it shows the most closely allied species or variety from any of the surrounding islands. (For details, see page 16.) The following are the names of the species:—

Fig. 1. *Papilio Gigon*, from Celebes; *P. Demolion*, from Java.

Fig. 2. *Papilio Macedon*, from Celebes; *P. Peranthus*, from Java.

Fig. 3. *Papilio Androcles*, from Celebes; *P. Antiphates*, from Borneo.

Fig. 4. *Papilio Telephus*, from Celebes; *P. Jason*, from Sumatra.

Fig. 5. *Papilio Miletus*, from Celebes; *P. Sarpedon*, from Java.

Fig. 6. *Papilio Agamemnon*, var., from Celebes; *P. Agamemnon*, var., from Sumatra.

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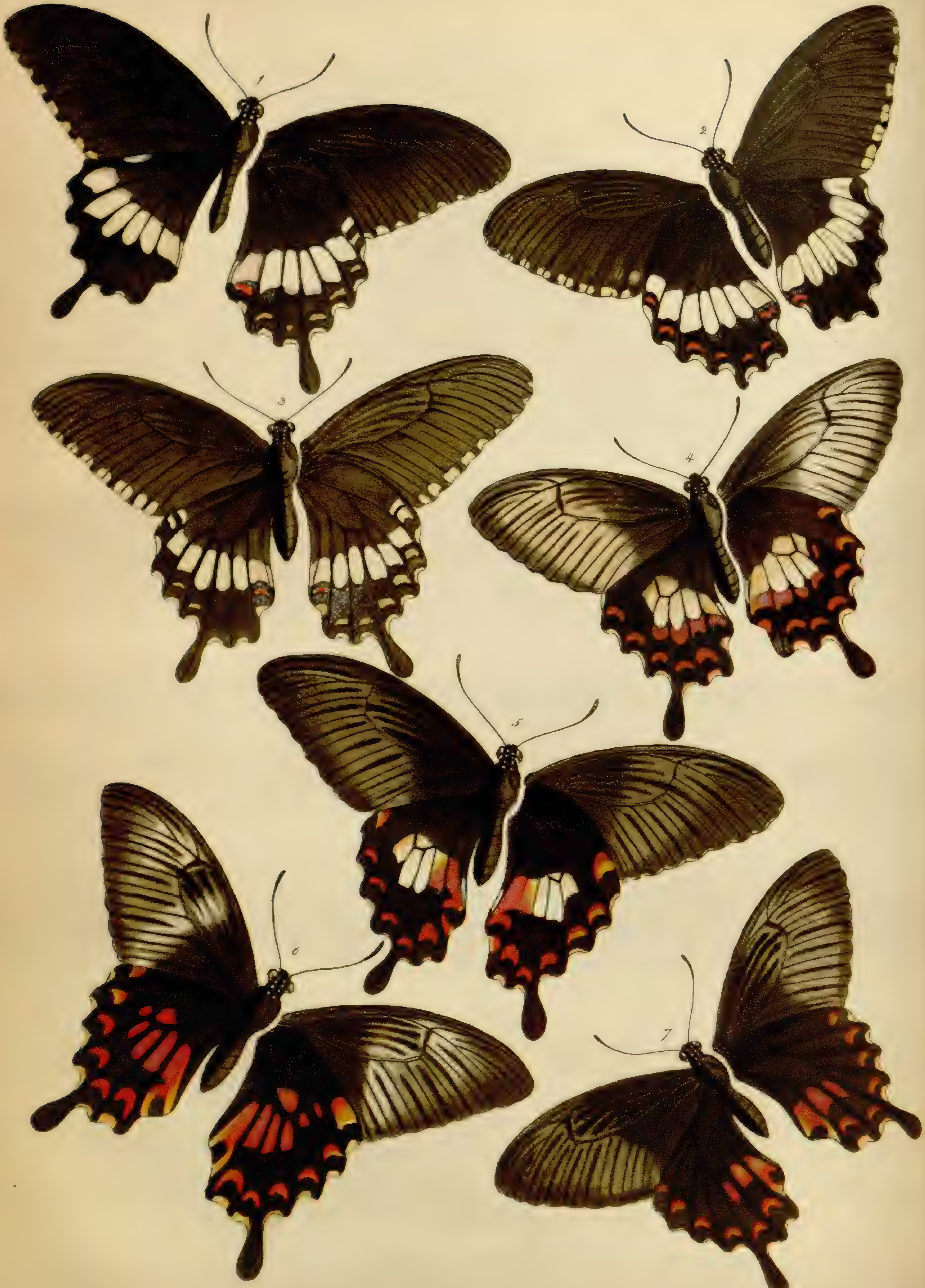
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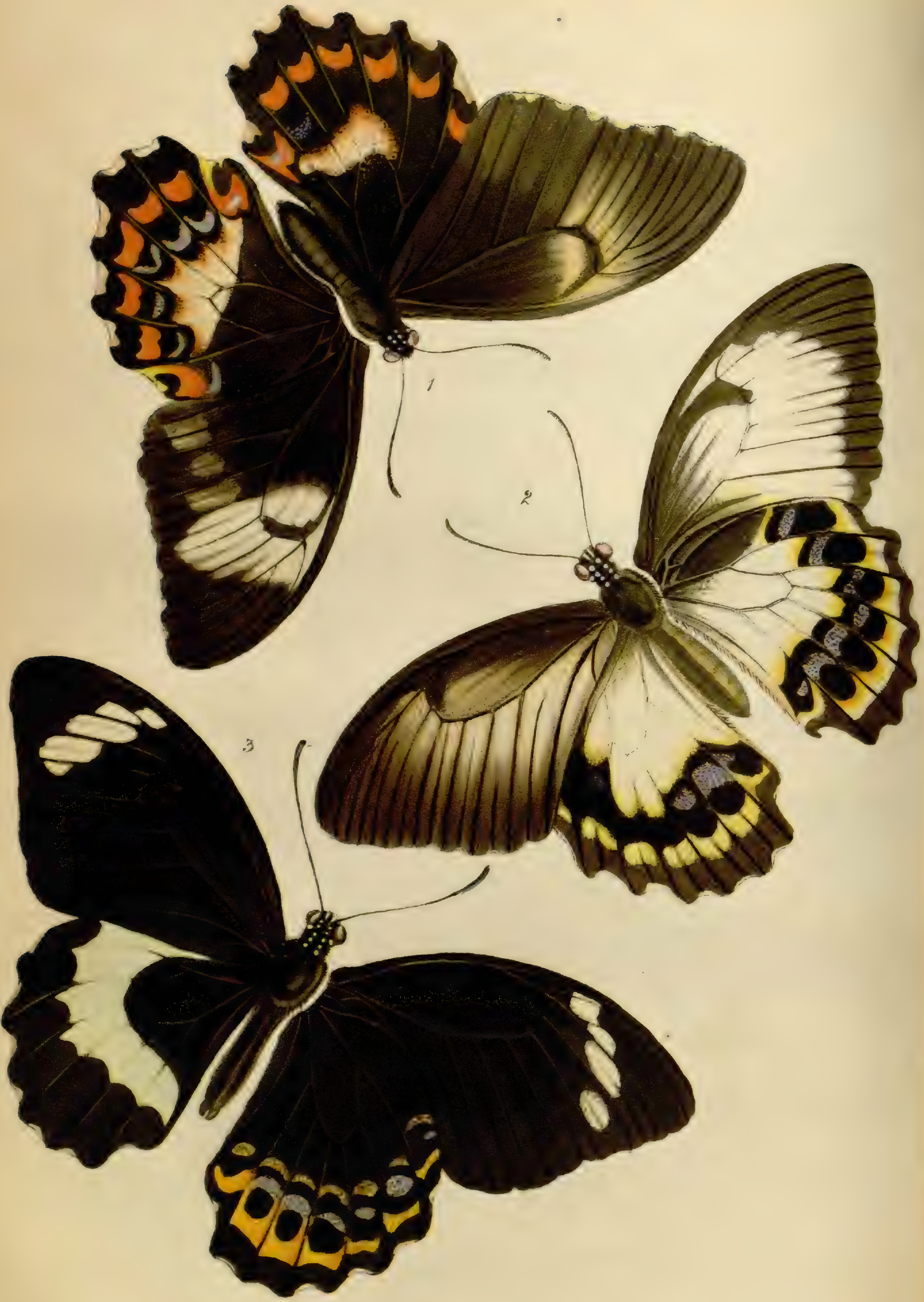
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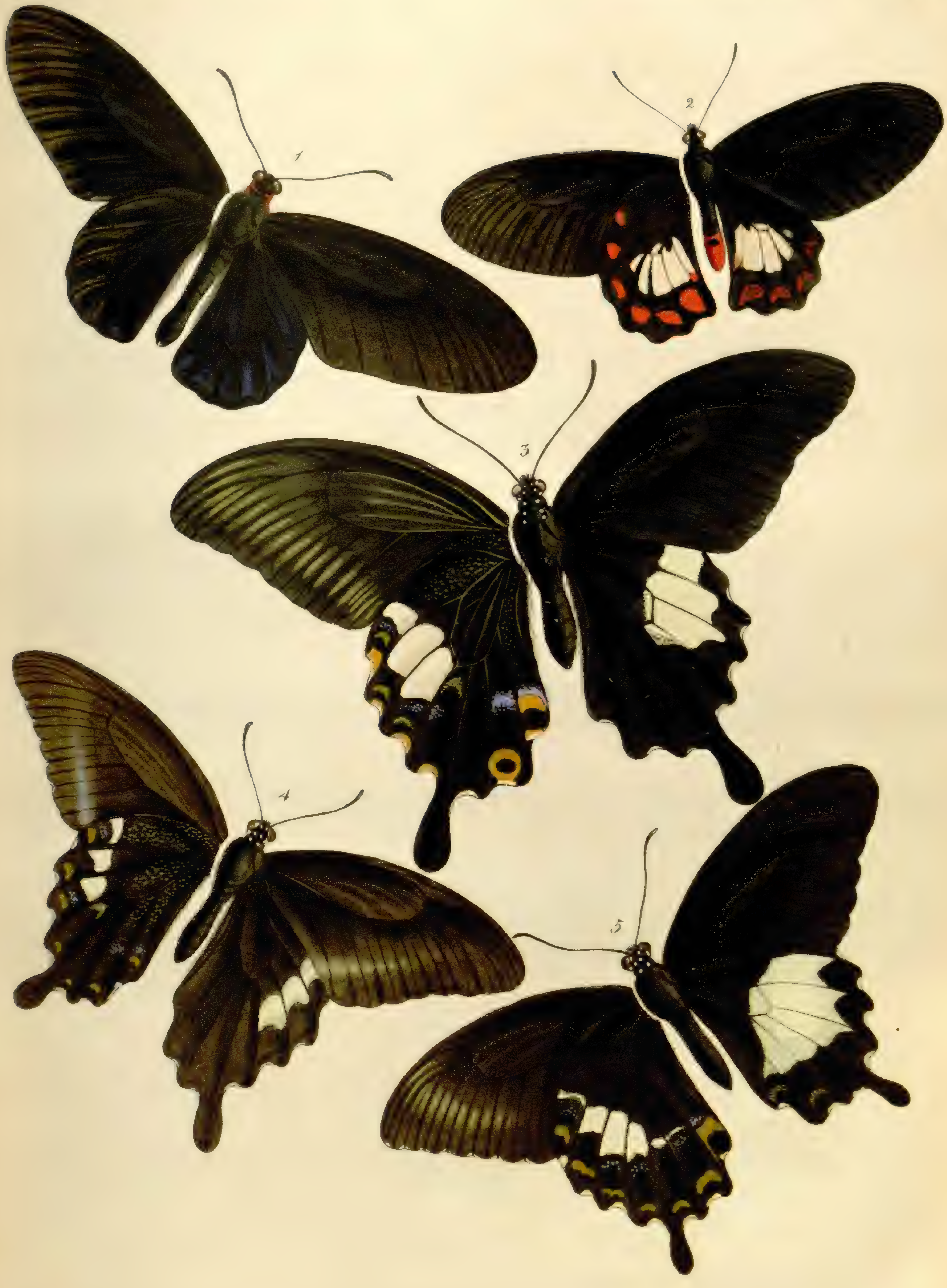

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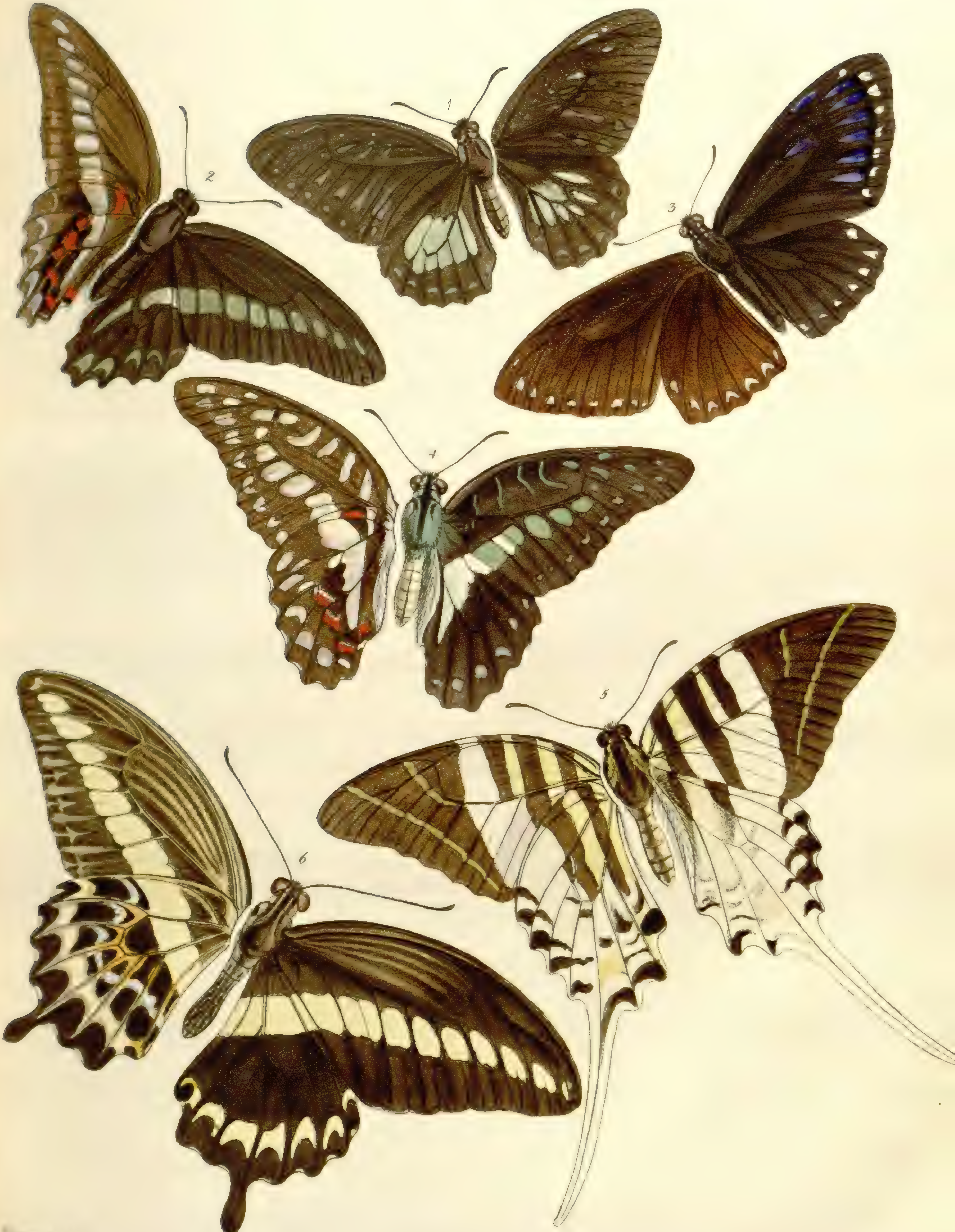
Vincent Brooks Imp.

J. T. Townsend del.

Vincent Brooks, Imp.



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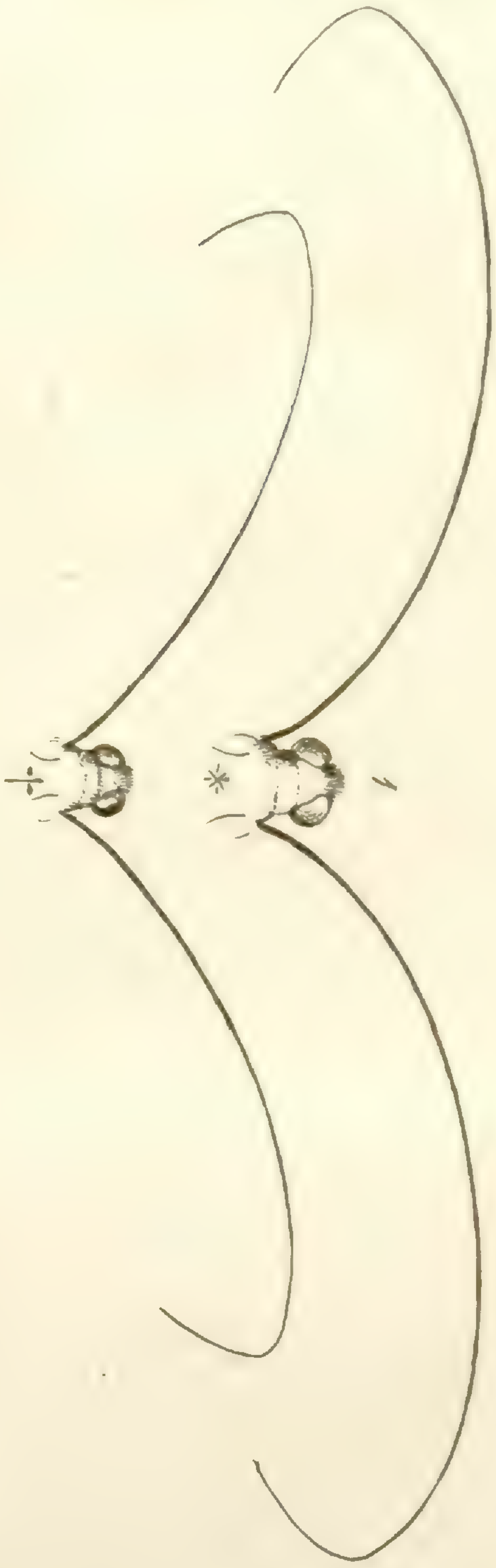
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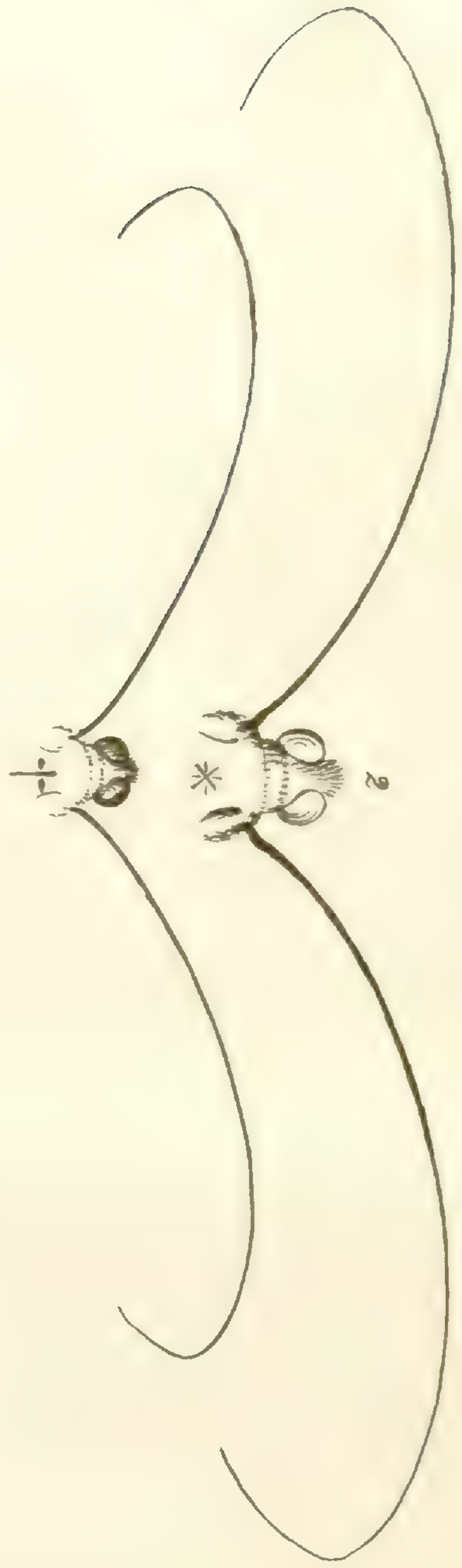
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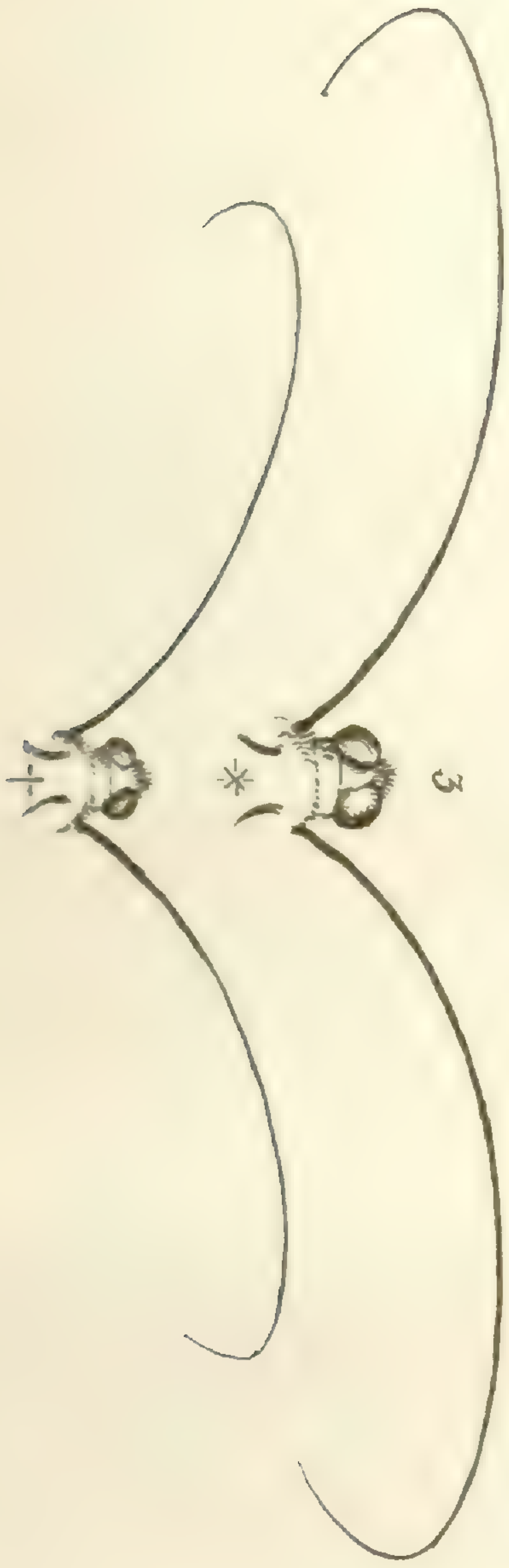
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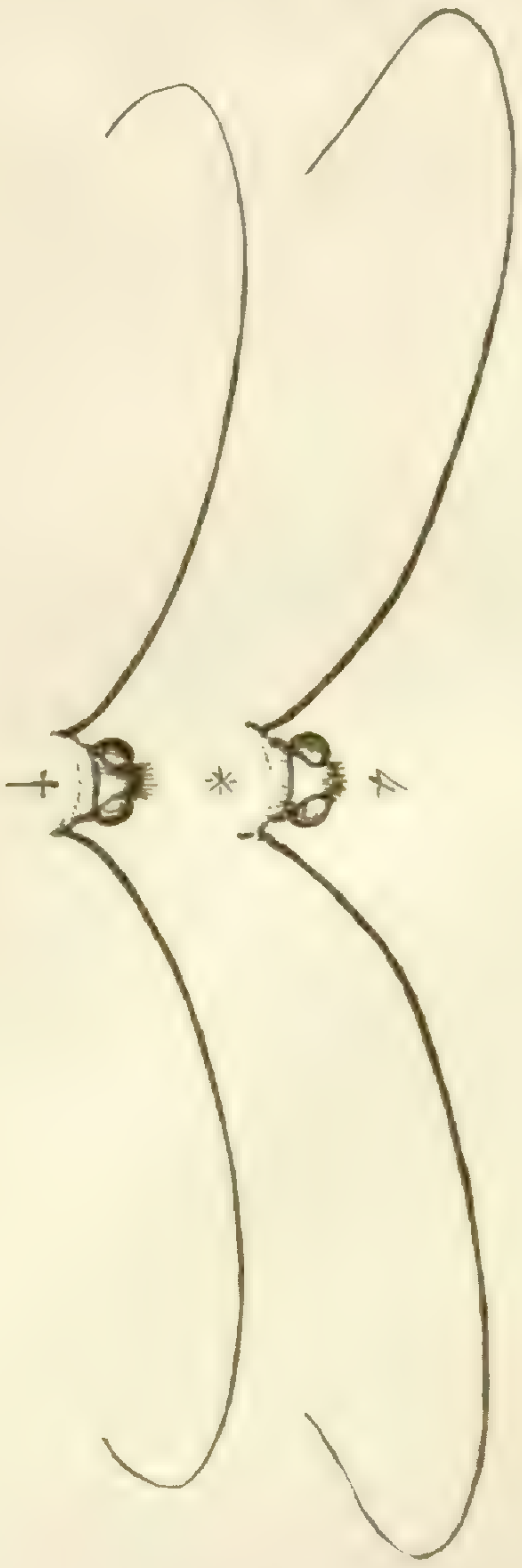
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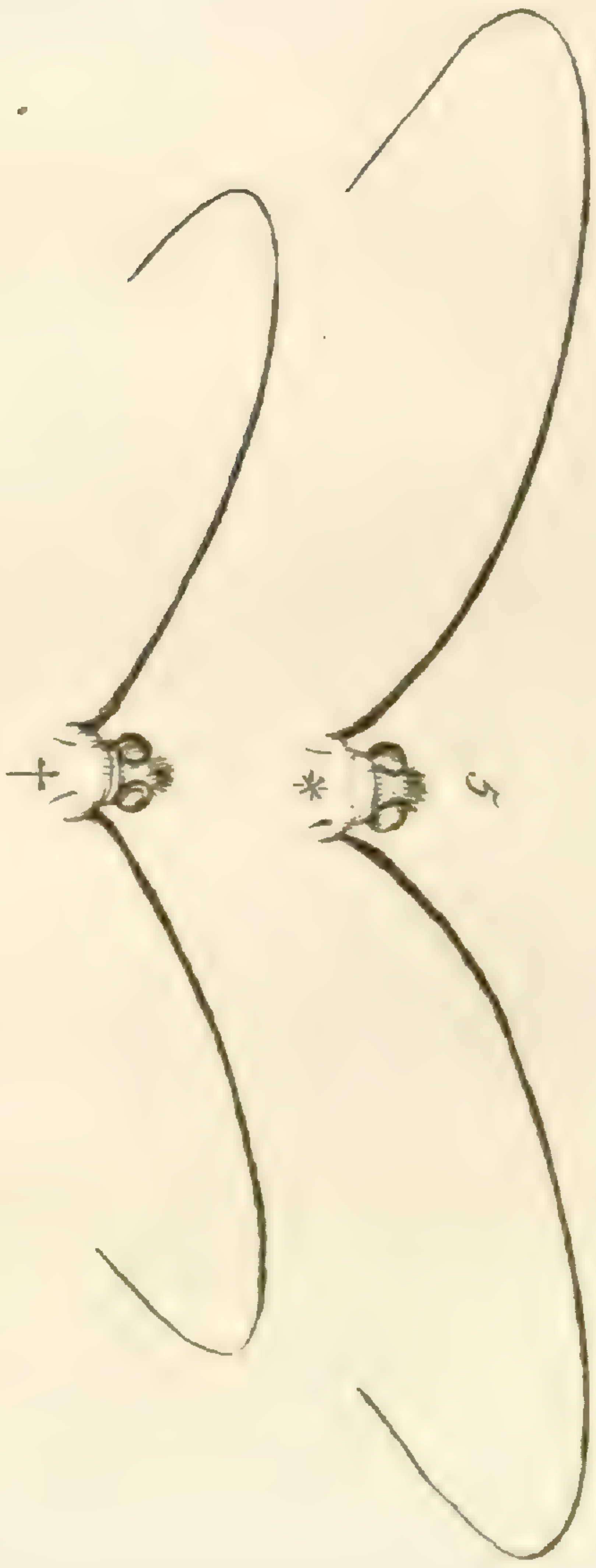
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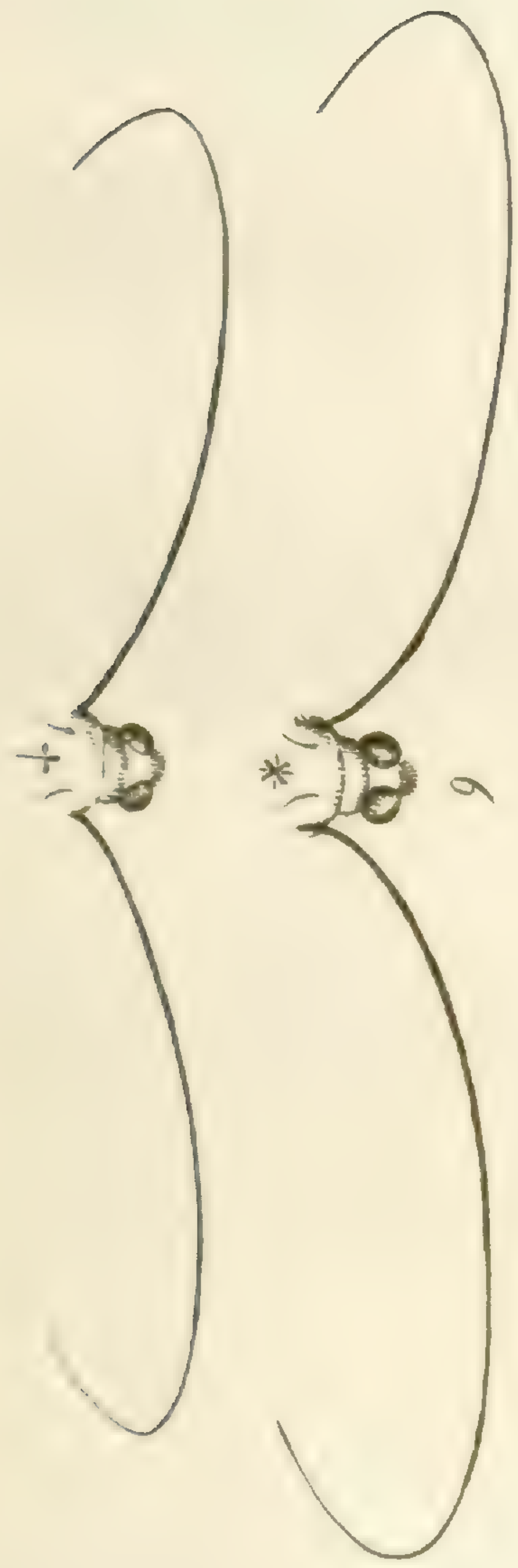
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J. O. Westwood, del.

Vincent Brooks, Imp.

THE

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M.DCCC.LXV.

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(Plates IX.–XIII.)

Read December 1st, 1864.

Of the Helminths hitherto described, those belonging to the Nematode group far exceed in number of species the representatives of either the Trematode or the Cestode orders, and, as far as our present knowledge extends, they have also a wider distribution as parasites amongst the various members of the animal kingdom. Thus, commencing with the *Acalephæ*, we find the so-called *Nematoideum Cydippes* taking up its residence in the substance of the body of one of our smaller jelly-fish, and thence onwards through higher and diverse types of animal life they are found, in more or less plurality, infesting representatives of all the principal orders and classes, till we come to man himself, who is the chosen habitat of no less than twelve species. Happily, however, whilst thus numerous and widely diffused, their effects are less pernicious and more seldom fatal than those resulting from the presence of individuals of the Trematode or Cestode types in their various stages of development[1].

As regards the actual number of parasitic Nematoids at present known, it has been computed by Dr. Cobbold, in his recent work on 'Entozoa,' that these do not amount to more than about 550 distinct species; and when I mention that within a space of fifteen months I have obtained from a few limited regions no less than 100 new species of free Nematoids, some idea may be formed of the numerical importance of this last group, concerning which, till within quite a recent period, our knowledge has been so vague and unsatisfactory.

Borellus[2], more than two centuries ago, seems to have been the first to recognize and describe a member of this family; and we must look, therefore, upon the so-called "Vinegar Eel," whose discovery he announced, as the first known representative of this group of non-parasitic Nematoids to which I refer. The same animal was subsequently seen by Power, Hooke, Leeuwenhoek, Baker, Spallanzani, and other pioneers of microscopical research, who soon found a companion for it in its near ally, the "Paste Eel." Then came the discovery by Needham[3], in 1743, of the wonderful *Vibrio tritici* and its young so strangely tenacious of life; and afterwards Otto Müller[4] was followed in his recognition of certain minute microscopic Nematoids found in fresh or salt water, and amongst Confervæ, by other naturalists, the principal of whom are Bory[1], Steinbuch[2], Dugès[3], Ehrenberg and Hemprich[4], Nordmann[5], Dujardin[6], Oken[7], Quatrefages[8], Grube and Leuckart, Diesing[10], Max Schultze[11], Leidy[12], Kühn[13], Carter[14], and Eberth[15]. The labours, in this direction, of these scientific observers have resulted in the discovery of about eighty species of free Nematodes found in various parts of the world. It is, however, to the researches of Dujardin, Eberth, Carter, and Diesing that we have been principally indebted for our knowledge of this group. Dujardin was the first who seemed to entertain comprehensive notions as to the extent and probable diffusion of these animals, and, besides the discovery of several new species, added more precise descriptions of them than the extremely scant details concerning the anatomy of the earlier forms furnished by Otto Müller, Ehrenberg, Hemprich[16], and others. Carter, besides the discovery of ten new species, has contributed many interesting anatomical details; and Eberth, in his recent valuable memoir[17], has added much to our knowledge of their anatomy, in addition to the descriptions and beautiful figures which he has given of twenty-three new species; though he, like his predecessors, has tended to create great confusion in the nomenclature, by describing under the same generic name species differing notably in the anatomical arrangement of important parts, as I shall hereafter endeavour to explain. It is by his writings, rather than by special anatomical examinations of his own, that Diesing's name is associated with this group, since he has not only treated of them in his 'Systema,' but also has lately made the classification of the Nematodes, both free and parasitic, the subject of a special communication[18].

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[1] As exceptions to this general rule, three Nematoids may be cited which are undoubtedly most serious pests to the human race, from the frequency of their occurrence and the serious diseases to which they give rise: these are the Guinea Worm, which is so prevalent in the tropical parts of Asia and Africa; *Sclerostomum duodenale*, principally met with in Egypt, and so common that Dr. Griesinger considers about one-fourth of the whole population suffer more or less from "Egyptian chlorosis" (a malady that is frequently fatal), due to the presence of these parasites in the situation indicated by its name; and, lastly, *Trichina spiralis*, which has attracted so much attention of late, owing to the frequency of trichinosis, in various parts of Germany more especially.

[2] Obs. microscop. Centur. 7, 1656.

[3] Micr. 99, tab. v. 7.

[4] Animal. Infusoria. 4to. Hamb. 1786.

The writings of Carter afforded the stimulus which induced me to inquire into this subject; for, like himself, having been interested in the anatomy of the *Dracunculus*[19], my attention was arrested by his interesting paper on the "Microscopic Filaridæ in the Island of Bombay"[20], and my search for similar free Nematoids in this country has been rewarded by the most gratifying results—more especially as, with the exception of the "Paste" and "Vinegar Eels," the *Vibrio tritici*, and one or two unknown species always alluded to by the same name of *Anguillula fluviatilis*, no representatives of this group have, I believe, yet been described as existing in Great Britain: hitherto the harvest has been with the continental naturalists, with Dr. Leidy in America, and with our own countryman Carter in India.

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[1] Encycl. Méth. 1824, p. 777, tab. iv. f. 20–23.

[2] Naturforsch. xxviii. St. 233, tab. v.

[3] Ann. des Sc. naturelles, 1826, tom. ix. p. 225.

[4] Symb. Phys., seu Icones et Descrip. Animal. evert. 1828.

[5] Lamarck's Hist. Nat. des Ann. sans vert. 1840, tom. iii. p. 665.

[6] Hist. Nat. des Helminthes (Suites à Buffon), 1845, p. 230.

[7] Lehrb. d. Naturg. Zool. 1. Abtheil. p. 192.

[8] Ann. des Sciences Nat. 1846, p. 131.

[9] Wiegmann, Archiv, 1849, Band i. pp. 157, 358.

[10] Systema Helminthum. Vindobonæ, 1851, vol. ii. p. 122.

[11] Icones Zootomicæ, Carus, tab. viii. figs. 1–3.

[12] Journ. of Acad. of Nat. Sc. of Philadelphia, vol. iii. (1856) pp. 135–152 (2 plates).

[13] Zeitsch. für wissen. Zool. 1857, t. ix. p. 189.

[14] Ann. of Nat. Hist. 1859, vol. iv. pp. 28 and 98, pls. 1–3.

[15] Untersuch. über Nematoden, mit neun Kupfertafeln. Leipzig, 1863.

[16] Any attempt to recognize the species of these authors seems quite hopeless, since, oftentimes, no other anatomical details are given, save the mere length and breadth, and for figure, if any, only a mere outline form—occasionally a simple white space on a black ground.

[17] My species were already found, drawings made, and a rough draft of this paper written before I was made aware of the researches of Dr. Eberth upon the same subject, by the sight (November 1864) of his admirable monograph. I find he has anticipated me in a few of the anatomical facts which I had worked out independently; the coincidence, however, cannot but be satisfactory in a field beset with so many conflicting statements of different observers.

[18] Sitzungsberichte der Wiener Akademie, 1861, Bd. xlii. no. 28, p. 612.

[19] Transactions of the Linnean Society, vol. xxiv. part 2, p. 101.

[20] *Loc. cit.*

As a result of my investigations, I am inclined to believe that these free Nematodes will be found to constitute one of the most widely diffused and numerically abundant groups in the whole animal kingdom, rivalling, in the first respect at least, the almost ubiquitous Diatomaceæ. A statement of some of the principal situations in which I have met with these animals will best illustrate this proposition. Thus, beginning with the land- and freshwater-species, I have found them in all the specimens of soil examined, in moss, various species of lichen, about the roots of fungi[1], also the roots of grasses, and between the sheaths of their leaves, amongst the mud of ponds and rivers, on the freshwater Algæ, amidst decaying liverworts and mosses, and on submerged aquatic plants. The marine species exist in great abundance in the surface-mud of rivers and estuaries[2], in the sand, and amongst the small stony débris under the shelter of rocks, as well as in the tide-pools, where they swarm about the roots of the corallines and on some of the smaller and finer sea-weeds, especially those having a dingy appearance from the presence of Diatomaceæ. And, lastly, two or three species I have found in the greatest abundance, as pseudo-parasites, within the substance of some of the softer sponges. So numerous are they in these latter situations, that it is rather surprising they should have so long escaped the attention of marine zoologists. From the transparency of their integuments, they are not only beautiful microscopical objects, but also admirably adapted for anatomical research; and Dr. Eberth and myself have already worked out so many interesting structural details, that I have no doubt, should the investigation be followed up by other observers, the question of the anatomy and real affinities of the Nematoids, at present so doubtful, would be soon placed upon a satisfactory footing.

The specimens I have examined have varied in length from $\frac{1}{70}''$ to nearly $\frac{3}{4}''$, almost all the larger forms being marine, though *Dorylaimus stagnalis*, Dujard., is about $\frac{1}{3}''$ long, and far exceeds in size any of the other land or freshwater species I have met with. In their various habitats individuals of all ages may be seen, from the young, immature and non-sexual embryo just emerged from the egg or its parent, up to the adult condition; and frequently the ova of species infesting a particular sea-weed may be seen attached to it, whilst the parent worms are gliding and twining, serpent-like, amongst its branches. This fact alone would induce one to believe that these animals are never parasites at any stage of their existence, even if this view were not confirmed by the existence of anatomical peculiarities which seem to distinguish them as a group from the parasitic forms in general. Since, however, the announcement of the discovery of so many free Nematoids is likely to suggest to the minds of many the belief that these are identical with the parasites, being merely the revelation of another stage of their life-history, which has hitherto been hidden from us, it seems desirable to bring forward some evidence to disprove such a supposition, and establish the claim of these minute creatures to a distinct and independent place in the animal kingdom—and more especially so since precisely such a view has been taken by one of the principal writers on these free Nematodes. For, at the conclusion of his paper before mentioned, Carter, speaking of the uncertainty still existing with regard to the early history of the *Dracunculus*, adds, "It remains a subject for future and interesting inquiry, but not more so than the still further elucidation of the Filaridæ generally, both free and parasitic; for when we consider that the former abound in species, and are spread in myriads probably all over the world, where there is vegetable matter for them to feed upon, in salt as well as in fresh water, in the sea and on the land, while the latter inhabit all animals, perhaps, more or less, down to the lowest worms; that many of the former[1] leave their habitat and vegetable food for a temporary residence in animals, to live thus on animal food, and that therefore *the whole of the parasitic forms may be originally derived from the free ones*"; for these, and other reasons, he says, "these worms, at first apparently insignificant from their thread-like form and scarcity, are seen to assume an importance in organic creation which calls for a much more extended study of them than they have as yet received" (p. 112).

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[1] I have not been very successful in finding these animals on or in fungi, though Carter has discovered them in abundance at Bombay projecting from the conceptacles of a large species of the genus *Xylaria*, growing on the decayed trunk of a tamarind-tree. (Trans. of Med. and Phys. Soc. of Bombay, 1861, App. p. 1.)

[2] I have found six different species existing, more or less abundantly, in a small portion of mud that could be held on a shilling piece.

With the view of investigating this question, I made a careful analysis of the anatomical details and plates given by Dujardin, in his 'Histoire naturelle des Helminthes,' of the Nematoid Entozoa,—selecting this writer, not only on account of the more complete descriptions found in his work, but also in deference to his extensive practical acquaintance with this particular branch of his subject. The result of this examination has sufficed to convince me that the nearly constant combination of several important characters—so universal as to be typical of these free Nematodes—are only *probably* present in two or perhaps three of the parasitic genera. These distinct characters are furnished by the male and female genital organs,—the males having two equal subterminal intromittent spicules, with or without accessory pieces, whilst the females have the vulva situated at about the middle of the body, a short vagina, with a symmetrical double uterus, whose branches lie on opposite sides and are connected with a short and simple reflexed ovarian tube—the only exception to this arrangement being in a few genera, in which, the females having the vulva situated some way behind the middle of the body (about the commencement of the posterior third), the hinder segment of the uterus remains abortive and undeveloped (Pl. X. fig. 113), whilst the anterior segment retains its characteristic form.

On referring to Dujardin's classification[2], it will be seen that he has ranged the Nematoids into seven sections, together with an appendix containing the little-known or anomalous forms. The anatomy of the animals included in his first section, comprising the genera *Trichocephalus* and *Trichosoma*, is totally distinct as regards the arrangement of the genital organs from that above mentioned; those of his second, including *Filaria*, *Spiroptera*, &c., are distinguished "par la présence de deux organes copulatoires, ou pénis, *inégaux*," whilst of his third section, containing the genera *Strongylus*, *Leptodera*, *Dicelis*, &c., the members of which do possess two equal spicules, with or without accessory pieces, the genus *Leptodera* is the only one affording also the character of a uterus divided into two equal and opposite branches, with the vulva occupying a median position. This genus contains one species[1], the *L. flexilis*, found in the vas deferens of *Limax cinereus*. In his fourth section, comprising the *Ascarides*, the members of the second subgenus, *Ascaridia*, including several species found in the intestines of birds, comply with the requirements so far as the male intromittent organs and double uterus are concerned, but differ by the presence of the three prominent cephalic lobes and the filiform ovaries characteristic of the genus *Ascaris*. In his fifth group, Dujardin places these free Nematodes together with certain other genera. The sixth section, containing *Sclerostoma*, *Syngamus*, &c., contains only one genus, *Angiostomum*, having the before-mentioned arrangement of the male and female sexual organs; but the figures given by Dujardin of the only two species of this genus—one found in the lungs of *Anguis fragilis*[2], and the other in the intestine of a pulmonate Gasteropod—seem to indicate a totally different formation of the ovarian tubes. The individuals of the seventh and last section, including the genera *Dacnitis*, *Ophiostoma*, &c., are out of the question, from their not possessing a terminal mouth; and those of the appendix do not comply with other conditions[3].

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[1] Not strictly speaking Nematoids; the animals referred to, constituting the genera *Gordius* and *Mermis*, belong in reality to a nearly allied order, *Gordiacea*.—H. C. B.

[2] *Loc. cit.* p. 2.

This evidence seems a sufficient warrant for the belief in the non-parasitic nature of the animals in question, since it could scarcely happen, if these forms were ever parasitic, that they should not some of them—or, at all events, species of the same genera—have been met with in this condition, so as to enable us to include in the same genus parasitic and non-parasitic types. To me, indeed, it seems clear that these free Nematoids themselves, which can be detected in all stages of growth in external media, are not likely, as a rule, to be capable of existing also as parasites. Then comes the question, are they as a group distinguished by any particular characters from the parasitic forms? To which I think we are fairly entitled to return an answer in the affirmative, after the statements that have just been made, and from a consideration of other facts to be presently mentioned[4]. So far, too, this is in accordance with the views held by the leading helminthologists of the present day, who are almost all now disposed to believe that the parasitic Nematoids exist in an asexual condition within the body of an intermediate host, before host and guest are swallowed by those animals destined to harbour the sexually mature Entozoa—the conditions essential to their development seeming to necessitate this intermediate state, instead of that direct and continuous method of evolution from the egg to the adult animal which I have recognized in all the free Nematodes in their various habitats. Our knowledge of the life-history of the parasites is extremely defective; but what we do know concerning the so-called *Filaria piscium*, *Trichina spiralis*, and other immature Nematodes is confirmatory of this belief. Moreover, in his recent work on "Entozoa," Dr. Cobbold, speaking of the Ascarides, remarks, "In all situations where there is an abundant water-supply these parasites are more particularly common; and it is well known that the lowlands of Holland and the lake districts of Sweden are eminently favourable to their existence. All this is explicable enough from what we now know respecting the conditions which are essential for the rearing of the larvæ; but, as I have before observed, it is almost certain that the human body becomes infested, not by the drinking of water which may contain the sexually immature embryos, but by feeding upon the flesh of some quadruped, fish, or fowl which happens to represent the so-called intermediate host" (p. 313).

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[1] Another and much larger species has since been found by Dr. Baird in the abdominal cavity of *Siredon mexicanus* (Proc. Zool. Soc. 1858, p. 225, (Annulosa) pl. 52. f. 6, 7.

[2] This species, *Angiostomum entomelas*, I have lately discovered, and have satisfied myself, not only that it does not belong to any of the genera of free Nematodes at present known, but that it is distinguished from the members of this group generally by the form of its ovaries and the extreme thinness of its integument.

[3] The genus *Odontobius* being the only one concerning which there is any doubt, the nature of which will be explained in the systematic portion of this memoir.

[4] It is true that a few of these free Nematodes have been found within the intestines of other animals by Dujardin; but in all the cases related by him, their presence within the intestinal canal may be looked upon as accidental rather than necessary, they having been swallowed, as he suggests, by these animals either with or as food. Thus *Dorylaimus stagnalis* was found by him in the intestine of the Carp. He has found species of the genus *Rhabditis* within the intestine of small slugs and of the common Frog (which, in its turn, swallows the slug), as well as in the stomach of several fishes, and the general cavity of the body of the Earth-worm. It would be desirable to have additional obser-

Some additional points in the anatomy of the members of this group, to which I will briefly allude, seem to strengthen the view I have been endeavouring to enforce. In the first place, the integuments have a greater proportional thickness than in the recognized parasitic forms; and in the next, there is a marked difference in the number of ova or young produced: whilst the entozoid species are most prolific, furnishing offspring by hundreds, thousands, or even millions, in these free Nematoids the ova are relatively very large and few in number, being easily countable, and, for the most part, seen in single

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vations concerning the animals found in this last habitat, before we can be certain that they belong to any of the genera of free Nematoids, since it is perfectly certain that in his genus *Rhabditis* Dujardin includes many and most diverse types. Speaking of these Nematoids and the Earth-worm, he says, "Je l'ai vu plusieurs fois, soit à Paris, soit à Rennes, se développer en quantité prodigieuse, et former des amas blanchâtres dans des vases où j'avais conservé des lombrics avec de la moüsse et de la terre humide." Moreover it appears from the interesting experiments of Davaine ('Recherches sur l'Anguillule du blé niellé,' Paris, 1857, p. 64) upon the young of the *Vibrio tritici*, that their chitinous integument effectually protects them from injury within the alimentary canal of the cold-blooded animals. This was ascertained by experiments upon the Frog, the Triton, the Salamander, and a fish (*Cyprinus auratus*) belonging to the same genus as that in which the *Dorylaimi* were found by Dujardin. Davaine says, "Ingérées dans l'estomac de ces animaux, soit sèches, soit humides et vivantes, les anguillules de la nielle ont parcouru tout le tube digestif, sans avoir subi d'altération; elles ont été évacuées ou retrouvées dans le rectum, privées de mouvements, mais non de la vie, dont elles n'ont par tardé à reprendre les manifestations, après avoir été placées dans l'eau pure." This seems to afford a very probable explanation of the accidental presence of these free Nematodes uninjured within the *alimentary canals* of certain of the lower animals, though it does not at all account for their presence within the general cavity of the body of the earth-worm, as reported by Dujardin, or of *Naïs albida*, as related by Carter. It should be remembered, however, that the general cavity of the body in these animals is not a shut sac, since it communicates with the exterior by means of certain ciliated tubes, called by Dr. Williams (Phil. Trans. 1858, p. 93) "segmental organs." In these tubes of the earthworm a parasitic Nematoid (*Dicelis filaria*, Duj.), is known to exist in great abundance. The young of this animal might work their way through the patent terminations of the tubes into the abdominal cavity of their host; and it is even possible that minute free Nematoids might also work their way inwards, through these tubes, into the abdominal cavity of both *Nais* and Earthworm.

file within the genital tubes, though often occupying the whole width of the body. This is a condition of things quite in harmony with the several requirements of animals dependent upon such totally different conditions. The free Nematodes produce their ova or young at once in that environment which they are destined to inhabit, whereas the parasitic progeny are subjected to a multiplicity of chances and contingencies before they meet with the necessary conditions suitable for their development: there must be many blanks in order to ensure a few prizes. It is but another instance of the harmony subsisting between the observed biological history of an organized being and the physical conditions to which it is subjected and surrounded; and the difference in this respect between the two divisions of the order *Nematoidea* may not inaptly be compared to that existing between the predaceous cartilaginous fishes, on the one hand, and the ordinary osseous species on the other. We may note the same limited number of progeny in those forms whose young are most likely to survive, owing to their being produced viviparously or else with the egg enclosed in a coriaceous envelope, which, for additional security, becomes fixed by means of its tendrils to some rock or larger seaweed. Whilst the ova or young of such species may be numbered by units, for those of the majority of osseous fishes we may substitute, instead of units, millions or even billions.

Then many of the free Nematoids, more especially of the marine species, are provided with such rudimentary sense-organs as would be useless to a parasite. These exist in the form of distinct, reddish, conical and circumscribed masses of pigment, with the addition occasionally of transparent lens-like bodies, situated on the anterior part of the œsophagus, which doubtless subserve the purpose of rudimentary visual organs. And, lastly, almost all the free Nematodes are furnished with a caudal sucker, most highly developed in the marine species, to whom its utility is obvious, by enabling their smooth and polished bodies to adhere to the particular weeds which they infest, whilst these are swayed to and fro by the currents of the flowing and receding tide.

These various considerations lead me to believe that the free Nematoids constitute a group absolutely distinct from the parasitic forms; and I have dwelt upon this point, not only because it has not been enforced by previous writers, but also with the view of showing the untenability of the opposite hypothesis, advanced, perhaps somewhat hastily, by a most accurate observer, and one whose opinions generally are so worthy of credit. On this account, too, it does not seem to me desirable to associate with these animals, as Dujardin has done in his fifth section, "Enopliens," the two parasitic genera, *Passalurus* and *Atractis*—and this not simply on the arbitrary ground of their being parasitic, but because they neither of them comply with those structural conditions which were stated to obtain almost universally in the group in question. They appear to have been so placed by Dujardin, from the simple fact of their possessing a mouth armed with three teeth or jaws, which he took to be the typical character of this group, as shown by the name he applied to them. But a reference to the figures and descriptions of the species discovered by Dr. Eberth and myself will show that this is a structure quite exceptional —only met with in one or two genera, and therefore untenable as a family distinction. Diesing, also, in his recent communication on the classification of the Nematoids, has associated with these animals certain parasitic genera; and in this paper, as well as in his

'Systema,' under Ehrenberg's genus *Anguillula* (which is characterized in such general terms as to be perfectly capable of including the most diverse types) he places several species of minute Nematodes found in the intestines of insects, myriapods, and other animals, which were, for the most part, named by their original discoverers either *Ascarides* or *Oxyurides*. An examination of the extremely imperfect descriptions given by him, as well as of the figures by their original discoverers[1], seem rather to confirm the former position assigned to them; and from a consideration of the facts before mentioned, I certainly should not be disposed to place in the same genus parasitic and non-parasitic forms without more distinct evidence of their identity in anatomical details than we at present possess[2].

Since the classification of the Nematoids generally is in such a confessedly unsatisfactory condition, it is quite impossible to indicate the precise position or affinities of these non-parasitic forms. It seems, however, most desirable to retain for this group the family name of ANGUILLULIDÆ, proposed by Gervais and Van Beneden[3], which is not only generally suitable, but is also recommended by the fact of the most familiar and first-discovered species having still retained for them the generic name of *Anguillula*.

In the description of species and genera, and the arrangement of the former into the latter groups, an extreme amount of confusion prevails concerning almost all the forms hitherto discovered. This seems to have arisen partly from the meagre descriptions and indefinite figures given, and partly, with more accurate and precise observers such as Eberth, from their not having definitely settled what should be looked upon as points of generic importance. Some of this confusion I hope to be able to clear up in the more special portion of this memoir, and also to indicate, as far as my observation has extended, the value of different anatomical peculiarities as guides to classification.

Having thus sketched the history of our knowledge concerning this group of animals, I will now add a few details regarding their structure, habits, and mode of life. I shall merely give a brief outline, however, of their anatomy, as I intend to make this the subject of another communication.

The *integument* is mostly very transparent and hyaline in appearance, of a chitinous composition, and presenting sometimes transverse lines or dots, at others longitudinal markings[4], either alone or with transverse also; whilst in the remainder the integument appears perfectly plain, with no striæ of any kind. I have discovered numerous fine capillary canals through the integument, establishing a communication, apparently, between the exterior element and the peculiar lateral and median lines of these animals. These minute channels vary much in their number and arrangement in different genera, and promise to throw considerable light upon the nature of the curious lateral lines which have so long been a puzzle to anatomists. I have also detected these cutaneous pores in several of the parasitic Nematoids. In many species the integument is provided with setæ around the head, and more sparingly on other parts of the body; occasionally it is developed into papillæ around the mouth; and, besides the caudal sucker before alluded to, many of the males are furnished with a varying number of ventral suckers. Ehrenberg records the fact of his having observed *Anguillula recticauda* cast its skin. I have seen evidences of the same thing in many species, and suspect that, during the period of growth of the free Nematodes, it is the rule. In some few species, the integument appears to be glutinous. Thus *Oncholaimus vulgaris*, from marine mud, has always adhering to its surface minute particles of sand and *Diatomaceæ*, and in one case I saw two or three *Vorticellæ*. In *Spira parasitifera* I have frequently found specimens of a stalked fan-shaped diatom, probably belonging to the genus *Echinella*, as well as *Vorticellæ*, attached to the integument. Some few species, too, of the genus *Chromadora*, from marine mud, have been found enclosed in a tube like that of the *Sabella*, composed of agglutinated sand-particles.

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[1] For references, see Diesing's 'Syst. Helminth.' vol. ii. pp. 132–136.

[2] Diesing's *Anguillula macrura* I have lately found in the intestines of *Blatta orientalis*, and have ascertained that it has no resemblance to any of the free Nematodes at present known. Its anatomical characters are totally distinct from those of *Anguillula aceti*; and it seems best to place it in a distinct genus (*Streptostoma*), as was done by Dr. Leidy (Smithson. Cont. 1853, v. p. 46, tab. 7. f. 6, 7).

[3] Zoologie Médicale.

[4] These must not be confounded with the longitudinal muscular bundles seen through an unstriated integument.

The *alimentary canal* commences wih a terminal rounded mouth, either opening into a dilated pharyngeal cavity or communicating at once with the œsophagus. This latter is often distinctly muscular, and has sometimes a pretty equal calibre throughout, whilst at others it is provided with one or two rounded or oval muscular swellings. The posterior one is occasionally provided with a few horny plates in its centre, and has generally been described as a stomach, though, I think, erroneously, since it seems to perform none of the functions of a stomach: it is not a receptacle for food, and the swelling is due to an increased muscularity of the walls of the œsophagus at this point, rather than to a dilatation of its central cavity. The structure seems to me to partake more of the nature of a valvular apparatus, partly facilitating the swallowing of food, and partly preventing the regurgitation of the freely moving and fluid contents of the intestine proper, during the rapid movements of the animal. This œsophagus is divided by a well-marked constriction from the intestine, which continues nearly uniform in size throughout the remainder of its course, terminating by a curved anal cleft on the ventral surface of the body at a variable distance from the posterior extremity. It is made up of a central tube and a mesenteric envelope, between which is situated a uniform layer of cells, containing light or olive-coloured fat-particles, probably having a rudimentary hepatic function. The arrangement of these cells and their contained granules is sometimes so regular as to give a distinctly tessellated appearance to the structure; whilst, at others, the intestine merely appears covered with a layer of irregularly disposed fat-particles, the containing cells being invisible, and their contained particles not definitely aggregated.

Some of the free Nematodes are viviparous; but, as before stated, most are oviparous, the ova being large and proportionally few in number. In many species they are so large as singly to distend the body; and in *Leptosomatum figuratum* I have measured one of this character of an elongated oval form, whose length was three times the breadth of the parent body. In *Dorylaimus stagnalis*, Dujardin, however, they are much smaller, admitting two or even three abreast within the uterus. In most of the genera the uterus and ovaries are formed upon the same type; and in those exceptional cases where the posterior segment remains undeveloped, it may still be seen in a rudimentary condition in the genus *Tylelenchus* (Pl. X. fig. 113), whilst in others little or no trace of it can be recognized in the adult animal. The male organs consist usually of a long tube proceeding from the junction of two elongated sacs or testicles, which occupies the ventral aspect of the body, and terminates at the anal cleft, or, as in *Monhystera ambigua* and *M. disjuncta* (Pl. IX. figs. 12, 13), a little anterior to it. In two species, *M. ambigua* and *Diplogaster filiformis*, I have failed to detect any horny intromittent spicules, whilst in the remainder I have always found two equal spicules, either alone or with one, two, or four accessory pieces.

The *glandular* and *water-vascular* systems are so intimately connected with one another, that it seems best to include in the same notice what little I have ascertained concerning their relations. The whole inner surface of the body is lined by a glandular substance, more highly developed in some species than in others, similar to what I described in the Guineaworm, and to what has been met with in some of the parasitic Nematoids by Eberth and other observers. In addition, in several species there are one or two pyriform glandular masses connected with the vagina (Pl. XI. fig. 147; Pl. XIII. figs. 189, 192), and also others near the anal cleft (Pl. XI. fig. 143; Pl. XIII. fig. 226), which have already been observed by Eberth, and termed by him "vaginal" and "anal glands" respectively. He has also described and figured two or three elongated sacs proceeding from the posterior extremity of the body, and has termed them tail-glands (Schwanzdrüsefi): these I had observed also, but, from the fact of their being most developed in those species in which the caudal sucker is largest, and from their not presenting the usual granular appearance of the other unmistakeable glands, I have always looked upon them rather as contractile sacs in some way connected with the operation of the sucker, and shall speak of them henceforth as *sucker-tubes* (Pl. XI. figs. 126, 151). In nearly all the marine species, I have recognized a glandular excretory organ, opening by means of a long duct on the abdominal aspect of the œsophageal portion of the body (Pl. XI. fig. 151; Pl. XII. fig. 164), but have found no structure precisely answering to this in the land and freshwater species, though in four of these genera, *Tylelenchus*, *Plectus*, *Aphelenchus*, and *Cephalobus*—the members of which all possess the same remarkable tenacity of life—a modification of the same organ evidently exists. In these genera I have failed hitherto to detect the entire structure, and have only succeeded in recognizing the curved, more slender, and rigid duct with which it terminates (Pl. X. figs. 79, 97, 104, 112). Two lateral cellular canals, essentially similar to the peculiar fat-canals or lateral lines of the parasitic Nematoids, are met with, well developed, in many species, between which and the external medium I have been enabled to detect numerous communications by means of a variable number of integumental pores[1]. In three of the four land and freshwater genera above mentioned I have detected, instead of these canals, two lateral, double-outlined, colourless vessels, somewhat similar to what I described in *Dracunculus*[1], and which are most apparent in *Tylelenchus tritici*. In this species, from their being longer than the body, they are wavy or even convoluted, and I have several times succeeded in isolating them completely from other structures[2]. These seem to correspond to the axial vessels contained within the lateral lines[3] of *Ascaris lumbricoides*, *A. megalocephala*, and other parasitic Nematoids.

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[1] These pores seem evidently to have been recognized by Eberth at the anterior and posterior extremities of his *Phanoderma bacillatum*, though he put a totally different interpretation upon the appearances he observed, since he considers and speaks of them as skin-glands (*Hautdrüsen*), *loc. cit.* p. 6.

I have met with no distinct traces of a *nervous* system in these animals, the only thing which might be at all mistaken for a portion of such a system being the peculiar ring (also observed by Eberth) surrounding the œsophagus in some of the marine genera[4], concerning the nature of which we have both arrived, independently, at the same conclusion, that its connexions and structural peculiarities rather point to its affinity with the glandular than the nervous system (Pl. XI. fig. 126). The absence of any traces of nervous filaments in connexion with the well-developed ocelli of so many of the marine species affords also strong negative evidence of the absence of such a system in the Nematoids.

The *muscles* of the body seem to be, the same as in other Nematodes, composed of four longitudinal bundles, two dorsal and two ventral, with an interspace on either side. In neither free nor parasitic have I been able to recognize the circular fibres spoken of by some anatomists.

Much difference exists as to the muscular power and activity of different species. The *Dorylaimi* and *Tylelenchi*, for instance, are very slow and tardy in their movements; *Sphærolaimus hirsutus* is remarkable both for its activity and power; whilst the different species of the genera *Theristus* and *Tachyhodites* are distinguished by rapidity of movement. The mode of locomotion of all is indeed most characteristic, being effected by eel-like undulations of the body, which at once distinguish these animals from the *Naï-*

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[1] Linn. Trans. vol. xxiv. p. 113, pl. 21. fig. 26 *b*.

[2] Although not yet detected, I have little doubt that similar vessels will be found to exist in the fourth and nearly allied genus *Cephalobus*.

[3] Since this paper was read, I have ascertained that not only the lateral lines, but also the mid ventral and dorsal lines of the two *Ascarides* above mentioned are only local developments in these situations of a fibro-cellular layer lining the whole internal surface of the chitinous integument, and separating it from the four great longitudinal muscles. These developments (occupying the muscular interspaces) differ notably from one another, inasmuch as those in the lateral regions, besides being much larger and more prominent than the dorsal and ventral cords, contain each a well-marked axial vessel. Whether this vessel exists in all the Nematoids seems very doubtful, as in some of the parasitic, and in nearly all the free species, in which the lateral lines can be detected, they appear to be simple aggregations of large cells, bounded, internally at least, by a limiting membrane—though I think we may fairly look upon these lateral lines of the free Nematoids as homologous with the lateral lines of the *Ascarides*, and consequently infer that they are also integral parts of a general subcutaneous cellular layer. In this cellular layer of *A. lumbricoides* and *A. megalocephala* I have also detected a series of delicate transverse vessels, mostly in pairs, extending from the mid dorsal to the mid ventral line, and much more numerous on the right than on the left side of the body. These, I fancy, open externally by means of minute pores through the integument, though hitherto I have been unable thoroughly to satisfy myself of the fact.

[4] As yet I have only met with it distinctly in some of the marine genera, and, curiously enough, in those species only which have a plane or longitudinally striated integument, and never in those with transverse markings.

dinæ, with whom they are frequently associated, and also from the Annelids generally. Other movements of the aquatic species may be well seen if these animals are placed in a watch-glass and examined by a low power of the microscope, when they may be observed twining amongst the branches of the aquatic plants or algæ which they frequent, their gliding movements suggesting a resemblance to tiny serpents, till the delusion is banished by a sudden change in their method of proceeding, when, anchoring themselves firmly by means of their caudal sucker, they continue for some minutes swaying about with the greatest rapidity, darting their bodies hither and thither, and bending in all directions.

With respect to food, the free Nematodes seem to be almost exclusively vegetable feeders, though it is not often easy to recognize anything definite within their alimentary canal—the usual contents being a kind of granular débris, and in several species large oil-globules. In individuals of the genera *Cyatholaimus* and *Spilophora*, however, I have frequently seen the intestine filled with large Diatomaceæ, whilst in species of other genera I have occasionally made out a few cells of algæ. The quantity of large fat-globules often seen within the intestinal canal is remarkable, and also interesting in a physiological point of view, as an exemplification of the almost direct conversion of cellulose into fat and other products. In *Dorylaimus stagnalis* these large beads of fat are generally of a bright yellow, whilst in other species I have occasionally found them of a pure emerald-green colour, and in one instance even of a distinct magenta hue; but in the majority of species the fat is colourless. I have never yet seen one of these animals swallow a particle of food; but what they do take appears to remain a long time within the intestinal canal, becoming slowly and almost entirely metamorphosed into fat, as the primary stage of assimilation. In this respect they differ notably from the *Naïdinæ*, with which they are usually associated in both fresh- and salt-water mud; for with these, as with their near ally the Earthworm, the intestinal canal may be considered as little else than a highway road along which extraneous matter, containing organic particles, is continually passing. These latter animals are less fastidious in their appetites, swallowing at random, and appropriating the organic material only when within the alimentary tube; whilst the Nematodes are selective from the first, taking nothing but such vegetable substances as constitute their particular food. Their powers of prehension seem very limited; and I believe, from what I have seen, that their food is taken partly by suction, this being effected by the sudden dilatation of the otherwise habitually closed triquetrous canal of the œsophagus, by means of the radiating transverse muscular fibres of which its walls are composed. This rapid dilatation causes an inrush of fluid, with any particles that may be in front of the mouth; and I have several times observed air-bubbles and fluid enter and pass along the œsophagus in this way. How or of what nature is the food taken by individuals of the genera *Dorylaimus*, *Tylelenchus*, and *Cephalobus*, having a sharp, exsertile, spear-like commencement of the œsophagus, I cannot say: it seems difficult to account for the presence of such a structure, unless it were destined to pierce animal or vegetable tissues, and thus enable them to suck the organic juices—a supposition which seems borne out also by the thread-like dimensions of the œsophageal canal in the genus *Tylelenchus*. The so-called gastric teeth met with in some of the free as well as the parasitic Nematodes, in the terminal dilated portion of the œsophagus, constitute also, I believe, in reality, a valvular apparatus, probably connected with this same process of suction.

The power of repairing injuries possessed by these animals seems to be very low. In a specimen of *Oncholaimus vulgaris*, the head and œsophageal part of the body were severed from the remaining portion; and during the three days that the pieces were observed, although both portions continued to move about with tolerable activity, not the slightest attempt at repair was seen—no contraction even or closing up of the cut ends, such as almost instantly occurs when a *Naïs* is similarly injured. The chitinous nature of the integument in the Nematoids almost precludes contraction, and nothing like circular muscles seems to exist. On another occasion I found the anterior half of an individual of the same species moving about freely a fortnight after section of its body, but presenting no attempt at repair. Similar results have been arrived at with one or two other species, and with sections made in various parts of the body.

I have not yet obtained much positive information with regard to their duration of existence, but, from what I have seen, suspect it rarely exceeds from six to ten months[1]. In *Mononchus truncatus* I have ascertained that in about two months the embryos had attained two-thirds of their adult size, and were only then beginning to emerge from their asexual condition, the very first rudiments of a genital apparatus being just perceptible. The rate of growth after this seems to be still slow and gradual; and the females appear to die after the production of a single brood or batch of ova. Such is certainly the case with the *Vibrio tritici*; and, as pointed out by Davaine[2], the total duration of the *active* life of this animal is about nine or ten months.

The different members of this group vary much as to their tenacity of life. As a rule they are frail and delicate, and do not recover even after a slight desiccation of five or six minutes, thus differing remarkably from what I have at present observed with members of the four land and freshwater genera, *Tylelenchus, Plectus, Aphelenchus*, and *Cephalobus*: with all these there is a remarkable tenacity of life and power of recovery after what seems to be complete desiccation. This power of revivification, now so well known to be possessed by the young of the *Vibrio tritici*, was first ascertained by its discoverer, Turberville Needham, in 1743; and afterwards the same property was recognized by Spallanzani in certain species of minute Nematoids found in tufts of moss; and a series of experiments were instituted by him with the view of estimating the extent of this power. These experiments have been repeated and extended in the most careful and conclusive manner by MM. Davaine[3], Doyère[4], and Gavarret[5]; and the remarkable advantages proved to be possessed by these minute animals have been erroneously supposed by most writers to be characteristic of the whole group[6]. I hope to make more extended observations on this head, and to be able to point out more fully hereafter the particular genera in which this capability of resisting desiccation exists, with the anatomical peculiarities which distinguish them from their less fortunate allies. It is an established fact that the young of the so-called *Vibrio tritici* are capable of resuming their activity, by immersion in water, after having remained dormant within their seed-like gall for a period of twenty-seven years, since Baker was enabled to establish this fact in 1771 with specimens given to him by Needham in 1744[1]; and I have lately been informed by one of the Fellows of this Society[2] that he has succeeded in restoring them after a period of "about twenty years," though it was stated by Bauer in his well-known paper in the 'Philosophical Transactions' for 1822[3], and by other observers, that from five to eight years was the limit; whilst lately, in his valuable work on 'Entozoa,' Dr. Cobbold has reported the period to be no more than "four or even five years." These discrepancies depend doubtless to a certain extent upon the manner in which the gall has been preserved during the interval, and upon certain differences in the hygrometrical conditions to which it has been subjected, just in the same way as seeds retain their power of germination for a variable period under the influence of different methods of preservation. I have been able to verify the observations of Spallanzani, Dujardin, and others, regarding the degree of vitality of the Nematodes found in tufts of moss, though they do not in reality belong to the genus *Rhabditis*, as reported by Dujardin, but are distinct forms, which I have included in the genera *Plectus* and *Aphelenchus*. And, more marvellous still, I took, this summer, during the long-continued drought of months, from the top of a slate roof with a southern aspect, and fully exposed to the direct rays of the sun, a patch of the yellow lichen, *Parmelia parietina*, for the purpose of examination—though more with a view of making quite sure that there were no Nematoids in it than with the expectation of finding any—when, after placing a small portion with some water in a watch-glass, I was extremely surprised on looking at it with a lens about two hours afterwards, to see forty or fifty of these little Nematodes in the full swing of life and activity. But with these other Nematoids of moss and lichen it is not as with the *Vibrio tritici*, that this remarkable power is possessed only by young and immature individuals, since it is enjoyed also by adults having fully developed ova within them. I have found no representatives of these particular types in salt water; and, as far as my experience goes, those found in this situation are all incapable of being revived after having remained without water, on a slip of glass, for a few minutes. A statement apparently in direct opposition to this was made by Otto Müller in his 'Animalia Infusoria.' Two marine species, named by him *Vibrio gordius* and *V. anguillula marina* respectively, were stated to revive after desiccation by the addition of spring water; but, since he does not make any definite statements concerning the length of time during which the movements continued, I suspect that what he observed may be nothing more than what I have myself seen very frequently, namely, two or three tolerably brisk contractions immediately on the addition of the water, gradually becoming less marked, and finally ceasing altogether in less than a minute. This effect I imagine to be physical rather than vital, and due to the rapid imbibition of water by the previously dried animal.

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[1] The period of those species capable of revivification is, of course, altogether a variable quantity; and I speak more particularly concerning the *active* life of the other members of the family.

[2] Recherches sur l'Anguillule du Blé niellé. Paris, 1857.

[3] *Loc. cit.* pp. 39–61.

[4] Ann. des Sc. Nat. 2e sér. t. xiv., xvii. & xviii.

[5] Ibid. 4e sér. t. xi. p. 315.

[6] Davaine's observations come very near to the truth in this respect (Ann. des Sc. Nat. sér. 4, 1858, tom. x. p. 335.)

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[1] Lettre de Needham en réponse au mémoire de Roffredi, dans le Journ. de Phys. de l'Abbé Rosier, t. v. p. 227, 1775.

[2] W. H. Ince, Esq.

[3] "Microscopical Observations on the Suspension of the Muscular Motion of the *Vibrio tritici*."

With respect to the *Vibrio tritici*, I may state that this year I succeeded in infecting some wheat with young specimens taken from a gall several years old. As my stock was small, the method followed was that adopted by Bauer—that is to say, the placing some of the young Nematodes within the cleft of the seed, allowing them to dry in this situation, and then consigning the seeds to the earth in the ordinary way. This was done in the end of February last, when eighty seeds so infected were sown in a box containing ordinary soil; and on the 8th of July I discovered one plant evidently diseased. It was extremely stunted, being only about five inches in height; and the whole specimen was dry and withered, with the exception of the small and abortive ear. This contained no healthy florets, the diseased ones being about fourteen in number, each being composed of the slightly altered glumes and paleæ surrounding a *gall* of the usual size and ovoidal shape, instead of a germen. In confirmation of this view of the gall-like nature of the growth, as ascertained by Davaine[1], I may state that at the time when these bodies had attained their full size and maturity, the other healthy plants were only just flowering, the germens in them being minute and undeveloped. I am also able to testify to the probability of the correctness of Davaine's description of the precise method in which the disease is produced, and the young worms come in contact with the growing flower. Before his time the only observers who had attempted to explain the manner in which the young Vibrios reach the ear were Roffredi[2] and Bauer; and both these investigators imagined the little Nematodes obtained an entry to the vessels of the plant, and were so transmitted to the germen. Bauer, indeed, whose paper, apart from the special subject on which he wrote—namely, the degree of vitality of these animals—is full of inaccuracies, and whose figure and description of the adult animal is utterly unlike the original, imagined that the young, found in what he considered to be the diseased grain, were the products of a third generation in this spot, the two others having taken place within the vessels of the stem of the plant during the progress of the animals towards the flower. But the real process, according to Davaine, seems to be this:—When the infected galls are sown together with healthy seeds[3], the young in a week or so, according to the degree of moisture of the soil, make their way out of the softened gall, and, diffusing themselves in all directions, some come at last into contact with the budding plant just sprouting from the healthy seed, and then insert themselves between the sheaths of its leaves, gradually working their way round till they come to the innermost of these, where they remain for a variable time, without increasing much in size, till the rudiment of the future ear begins to form. The length of time during which they remain in this situation, and their degree of activity, depend upon the rapidity of growth of the plant and the moisture of the season. The remainder of the process may be best described in Davaine's own words; he says:—"L'épi du blé, avant de paraître au dehors, se forme et reste longtemps renfermé dans les gaînes des dernières feuilles. Les anguillules, libres dans ces gaînes, le rencontrent et peuvent s'introduire entre les parties qui le composent. Pour que l'invasion des anguillules soit suivie de la production de la *nielle*, il faut que la rencontre ait lieu à une époque très-rapprochée de la formation de l'épi. Lorsque celui-ci n'a encore que quelques millimètres de longueur, que les paléoles, les étamines et l'ovaire, ayant la forme d'écailles, ne sont point distincts les uns des autres, ces écailles sont constituées par des cellules naissantes très-molles, pulpeuses, qui se laissent pénétrer facilement, et c'est à cette époque que les anguillules en contact avec l'épi déterminent la production de la *nielle*, en s'introduisant dans leur parenchyme. Mais, lorsque ces écailles acquièrent la forme des diverses parties qui constituent la fleur du blé, lorsque le pistil bifide devient distinct, les anguillules ne pénètrent plus dans leur parenchyme, trop consistant sans doute, et la *nielle* ne peut plus être produite; c'est un fait que j'ai constaté par plusieurs expériences" (p. 18). This piercing and occupation of a part of the rudimentary flower arrests its development, though it stimulates growth. A gall-like body is more rapidly produced in the site which should have been occupied by the germen, whilst the young worms soon become perfectly developed males and females. These vary in number from two to ten or twelve in each gall, and, after producing an enormous number of ova containing fully formed young—which speedily liberate themselves, though they afterwards undergo little change—themselves die and wither, at the time when the gall begins to assume its characteristic purplish-brown or black appearance.

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[1] Davaine has occasionally found a small abortive germen within the same floral envelopes with the gall; and in this case the gall is most likely to have been produced in one of the rudimentary scales, which would have gone to form a stamen. He believes it may be formed out of any of the scales belonging to the central parts of the flower; and although, as a rule, all these parts participate in the formation of a single central gall, still occasionally as many as three growths of this kind develope within the same pair of *glumellæ*. On one occasion he found a growth of a similar nature, and with the same kind of contents, growing from one of the leaves of the wheat. After this, additional proof as to the nature of the growth is almost superfluous. All interested in this remarkable disease of wheat should consult M. Davaine's admirable memoir on the subject.

[2] Observations sur la Physique, t. v. p. 1, 1775.

[3] That the disease may be produced artificially, by placing the young within the cleft of a healthy seed, after the method of Bauer, I can have little doubt, after the result of my own experiment, though Davaine seems to be rather incredulous concerning this mode of its production (*loc. cit.* p. 16).

In harmony with this method of infection of the wheat by the *Vibrio tritici*, as revealed by Davaine, I may state that in several grasses I have found different species of these free Nematodes, lying between the inner sheaths of the leaves, near the bottom of the culm. In *Festuca elatior* I met with no less than five species in this situation, belonging to the genera *Dorylaimus*, *Mononchus*, and *Plectus*; and in the stalks of wheat and oats removed from stubble-fields I have frequently found specimens either of these genera or of *Rhabditis*, *Aphelenchus*, or *Cephalobus*. In addition to a malady of oats and maize similar to that of the wheat, and said to be produced by the same animal, Steinbuch[1], nearly a century ago, recognized a disease somewhat similar to the "purples" in two of the bent-grasses (*Agrostis*); and, from the frequent presence of these Nematoids in the situation named, I suspect such diseases of grass will be found more frequent, if specially looked after. As another instance of disease induced in plants by these animals may be mentioned the discovery of Kühn[2], who has ascertained that a long-known and recognized disease of the common teasel (*Dipsacus fullonum*) is owing to the presence of a number of these minute Nematodes, which gives some parts of the flower a white filamentary appearance. They seem to be endowed with the same tenacity of life as *Tylelenchus tritici*, and, from their correspondence in anatomical details, evidently belong to the same genus. Whilst speaking of these parasites of vegetables, I may again mention the fact that two or three of the most highly organized species of the free Nematoids I have met with, all the specimens of which are provided with well-developed ocelli, have been found infesting some of the British marine Sponges. Although there can be no doubt of the animal nature of these latter, still the organization of Sponges is so peculiar that the conditions of existence of these minute Nematoids within their interstices may, on the whole, be considered much more nearly allied to those of the non-parasitic Nematoids in general than to those to which the parasitic forms are subjected within the various organs of more highly developed members of the animal kingdom. There would seem to be no more reason why these animals should be considered parasites on account of their habitat, than that those Annelids with which they are often associated in the *Spongiadæ* should, for a like cause, be brought under the same designation.

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[1] Naturforsch. xxviii. S. 233, tab. v.

[2] Zeitsch. für wissen. Zoolog. 1857, t. ix. p. 189.

Classification.

The only two writers who have attempted to classify the free Nematoids are Diesing and Eberth; and since the opinions of both are so much entitled to respect, it will be only right for me to consider their respective schemes of classification, and point out, not only the nature of these schemes, but also in what way they appear to me to be defective.

Diesing's most recent communication is to be found in a paper entitled "Revision der Nematoden"[1], in which he treats of the classification of the Nematoids generally. I shall, of course, confine my attention to what he has to say on the free Nematoids. These, with one or two other genera of a doubtful nature, he includes under two families, the distinguishing characters of which he considers to be the presence or absence of cirrhi or setæ around the mouth. His arrangement is as follows:—

Family I. CIRRHOSTOMEA. Corpus capillare. Os terminale cirrhatum. Ocellata vel cæca. Penis haud vaginatus v. vagina tubulosa exceptus. Papilla suctoria caudalis nulla v. unica terminalis. Animalcula ut plurimum microscopica. Aquarum dulcium vel maris incolæ.

* *Ocellata.*
1. Phanoglene. 2. Enchelidium.

** *Cæca.*
3. Pontonema. 4. Amblyura.

Family II. ANGUILLULIDEA. Corpus capillare, inerme vel armatum. Os terminale sessile, v. in apice tubuli protractilis, inerme aut denticulatum, nudum vel papillis cinctum. Cæca, rarius ocellata. Penis haud vaginatus aut vagina dipetala inclusus. Papilla suctoria caudalis nulla vel unica terminalis vel duæ marginales. Animalcula minora. Aquarum dulcium vel maris incolæ, aut in animalibus variis endoparasita, nonnulla migratoria.

* Odontostomata. *Os dentatum. Cæca vel ocellata.*
† *Ocellata.*
5. Enoplus.

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[1] Sitzungsb. der Kais. Akad. der Wissensch., xlii. Band, No. 28, p. 595.

†† *Cæca.*

6. Oncholaimus. 7. Dorylaimus. 8. Odontobius. 9. Diplogaster.

** Anoplostomata. *Os edentatum.*

10. Dicelis. 11. Anguillula. 12. Angiostomum. 13. Leptodera. 14. Isacis.

Genera inquirenda.

15. Phacelura. 16. Potamonema. 17. Nema.

More extended observation has convinced not only myself, but also Dr. Eberth, that this character, derived from the presence or absence of cirrhi, selected by Diesing as a family distinction, is altogether too inconsistent and variable. Several of the genera placed by Diesing in that family the members of which are supposed by him to have no cirrhi contain species which are abundantly furnished with these appendages, such as *Enoplus*, *Oncholaimus*, and *Odontobius*; and, moreover, their presence or absence is not always a character of sufficient importance to be employed even as a generic distinction. Five of these genera too, *Dicelis*, *Angiostomum*, *Leptodera*, *Isacis*, and *Phacelura*, are composed of species which are not free Nematodes at all, but parasitic forms infesting various kinds of insects, mollusks, myriapods, &c., concerning which I have already expressed my unwillingness to admit their identity with the free Nematoids till such a relation shall be fully established by a more accurate and precise knowledge of their anatomy than we at present possess.

Dr. Eberth also rejects this arrangement of the free Nematoids by Diesing as unsatisfactory, and offers in its place a readjustment of his own. He divides them into two principal families, but is doubtful and uncertain about some genera, such as *Dorylaimus*, *Diplogaster*, *Phanoglene*, and *Pontonema*. His main divisions are as follows:—

1. *Anguillulæ.*
    - *a.* Nematodes with an unarmed mouth, with a cylindrical œsophagus, and well-marked stomach; without tail-glands or ocelli; partly free and partly parasitic.
    - *b.* Nematodes with an unarmed mouth and simple œsophagus, without stomach and without tail-glands.
2. *Urolabes.* Nematodes without well-defined stomach, partly with and partly without cirrhi around the mouth; with or without ocelli, but provided with well-defined tail-glands. Habitat, fresh and salt water.
    - *a.* Apharyngea.
        - *Amblyura. Phanoglene. Enchelidium.*
    - *b.* Pharyngea.
        - * Cæca. *Oncholaimus. Odontobius.*
        - ** Ocellata. *Enoplus.*

This classification is also extremely defective, though based upon characters having real importance, instead of such mere individual peculiarities as were adopted by Diesing. Eberth has also unfortunately attempted to range all the twenty-three new marine species discovered by himself under five of the old genera, with the result of greatly confusing the nomenclature, since I feel quite convinced, from an examination of the beautiful figures he has given of these forms, that they cannot properly be included under less than from eight to twelve distinct genera.

So far as my own experience goes, I feel assured that even now, with the accession of new forms brought to light by myself, it is altogether premature to attempt anything like a philosophical classification; we are as yet but on the threshold of our knowledge of the multiplicity of types which will doubtless soon be revealed if the investigation is taken up by naturalists at home, and *à fortiori* if the subject enlists the attention of scientific observers in various quarters of the globe. In this memoir I have accordingly not ventured upon what may be called a classification, though I have carefully drawn up tables presenting a differential analysis of the characters of those of the genera whose anatomical details are sufficiently known. This has been done principally with the view of assisting in the identification of the species already described. On looking over these tables, one cannot but be struck with the fact of the almost universal distinctness of the land and freshwater from the marine types. In only one undoubted instance have I met with representatives of the same genus inhabiting both fresh and salt water (*Rhabditis*), since the marine species *Monhystera ambigua* and *M. disjuncta*, at present placed in this freshwater genus, will in all probability ultimately be found to belong to a distinct type, by virtue of certain anatomical peculiarities which distinguish them from other species of that genus in which they have been temporarily placed. One species of the freshwater genus *Dorylaimus* is also reported to have been found in salt water by Dujardin.

The ventral gland, or excretory organ, does not appear to be so common in the freshwater as in the marine genera; and, as far as I have recognized it in the former, it presents certain structural peculiarities. The peculiar "œsophageal ring," too, I have only met with as unmistakeably existing in some of the marine genera, and in these, curiously enough (though in this respect my experience appears to be contrary to that of Dr. Eberth), only amongst such as have either longitudinal or no perceptible striæ of the integument, as I have never once met with it in any species presenting well-marked transverse striæ. The ocelli are much more marked and more frequent in the marine species, though even the possession of such a well-marked appendage as this is not a character of constant generic importance. In the genera *Monhystera*, *Cyatholaimus*, and *Chromadora*, for instance, certain species are provided with ocelli, whilst others are without them; and their presence or absence seems frequently to be connected with the nature of the habitat. The degree of complexity of the male intromittent organs is also increased in the marine genera, since in these as many as two or even four accessory pieces may exist, whilst in the land and freshwater types the spicules are either solitary or provided with one single, posterior, median accessory piece. The shape and number of these organs afford excellent generic characters of a most constant kind, with the exception that occasionally, in genera whose species have spicules only, representatives will be met with presenting also a single posterior accessory piece. Such is the case in the genera *Oncholaimus*, *Comesoma*, and *Monhystera*. It may be, it is true, that this accessory piece exists in a membranous and undeveloped condition in the other species, and so is not readily recognizable. The exact structure of the pharynx and œsophagus, the nature of the integumental markings or striæ, and the position and character of the duct of the ventral gland seem to me the other characters which, from their constancy, should be most relied upon in the construction of genera. The necessity of absolute accuracy concerning these details cannot be too strongly enforced, in view of the crude generalities which have been offered by some preceding observers as specific descriptions, many of which are absolutely useless as a means of identification, and serve only to swell the number of synonyms and uselessly perplex subsequent workers in the same field of research[1].

Family ANGUILLULIDÆ, Gervais & Van Beneden.

Free Nematoids.—*Body* cylindrical, tapering more or less at either extremity. *Integument* transparent, striated or plain; naked, or provided with papillæ or setæ; traversed by capillary pores; shed and renewed at intervals. *Caudal sucker* mostly present. *Glandular system* well developed; often single excretory organ in anterior part of ventral region. *Lateral lines* existing as cellular canals communicating with the exterior, with or without a central channel; in others replaced by distinct vessels. *Median lines* indistinct. *Nervous system*, none. *Ocelli*, when present, aggregations of reddish pigment on anterior part of œsophagus, with or without transparent lens-like bodies. *Generative organs—female*, composed of double symmetrical uteri and short reflexed ovarian tubes, with vagina near centre of body; vagina occasionally more posterior, with posterior uterine segment and ovary undeveloped; *ova* few, large: *male*, consisting of an almost simple seminal tube, and two equal horny spicules, either alone or with one or more accessory pieces.

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[1] The best method of detecting and capturing these animals I have found to consist in separating with ordinary microscopical teasing-needles the specimens of algæ or coralline into small fragments, on the surface of a square piece of glass covered with a thin stratum of fluid, the glass being laid either upon a black surface or, better still, upon a small mirror, when the larger species may be recognized with the naked eye, and the smaller with an ordinary watch-maker's lens. They are best captured by taking them up upon the pointed extremity of a feather. I have employed an ordinary quill pen, with its upper extremity cut off obliquely. In the case of marine or freshwater mud, it should be spread out with a little water into a very thin stratum, when, in a minute or so, various spots of disturbance will indicate the position of these or other minute animals.

I am indebted to the kindness of my friend Howard Fox, Esq., of Falmouth, for being able to pursue in this inland locality (Broadmoor, Wokingham) researches concerning the marine Nematoids commenced at Falmouth, since he has abundantly supplied me at various times with mud, sand, and algæ from the estuaries and tide-pools of that place.

TABULAR LIST OF GENERA.

I. LAND AND FRESHWATER.

Spicules two, equal, with or without a single posterior median accessory piece.

* *Integument plain, or with longitudinal markings. Ventral excretory gland wanting.*

† *Caudal sucker small.*

1. MONHYSTERA. *Integument* with lateral circular mark anteriorly. *Ocellus* single, often absent. *Pharyngeal cavity* none. *Œsophagus* cylindrical. *Uterus* unsymmetrical.

2. TRILOBUS. *Pharyngeal cavity* cup-shaped; no teeth. *Œsophagus* having three lobes at termination. *Males* with well-developed suckers in middle line above anal cleft.

3. MONONCHUS. *Pharyngeal cavity* large, oval, having one upper *tooth*-like projection. *Canal of œsophagus indicated by three bright lines.*

†† *Caudal sucker absent.*

4. IRONUS. *Pharyngeal cavity* small, long, and narrow. *Œsophageal canal bounded by three bright lines.*

5. DORYLAIMUS. *Spear* exsertile, at commencement of *œsophagus, whose canal is indicated by three bright lines. Males* having oblique integumental markings on posterior extremity, with or without small median suckers above anal cleft.

6. ANGUILLULA. *Pharyngeal cavity* very small. *Œsophagus* having oval swelling at termination, containing a simple valvular apparatus. *Uterus* unsymmetrical. *Spicules* long and narrow. *Accessory piece* single, distinct.

** *Integument with transverse striæ. Ventral excretory gland present or absent.*

† *Caudal sucker present.*

7. TRIPULA. *Striæ* well marked. *Pharyngeal cavity* none. *Œsophagus* with constricted portion at termination. Three large *pores* through integument in anterior part of ventral region.

8. DIPLOGASTER. *Striæ* transverse and longitudinal. *Pharyngeal cavity* cup-shaped, with small horny plates at bottom. *Œsophagus* having large muscular swelling at middle of length. *Sucker* very minute. *Accessory* portion of penis well marked.

[a]9. PLECTUS. *Pharyngeal cavity* long and narrow. *Œsophagus* having oval swelling at termination, provided with a complex valvular apparatus. *Ventral gland having twisted duct opening near middle of œsophagus. Uterus* symmetrical.

[a]10. APHELENCHUS. *Spear* simple, at commencement of *œsophagus,* which terminates in a large rounded muscular swelling. *Ventral gland-opening posterior to termination of œsophagus. Uterus* unsymmetrical. *Spicules* simple, without accessory piece.

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[a] All the animals belonging to the genera having this mark affixed to them have a modification of the ventral gland, and are endowed with a remarkable tenacity of life.

†† *Caudal sucker absent.*

[a]11. **Cephalobus.** *Striæ* well marked. *Head* slightly bilobed. *Pharyngeal cavity* none, or small. *Œsophagus* having rounded swelling posteriorly, containing a simple valvular apparatus. *Ventral gland-opening opposite posterior part of œsophagus. Uterus* unsymmetrical.

Males having caudal alæ.

[a]12. **Tylelenchus.** *Spear* with trilobed base. *Œsophagus* having a rounded muscular swelling about its middle. *Ventral gland-opening opposite posterior part of œsophagus. Uterus* unsymmetrical. *Caudal alæ* narrow, unsupported.

13. **Rhabditis.** *Striæ* transverse and longitudinal. *Pharyngeal cavity* cylindrical. *Œsophagus* having elongated swelling at middle, with rounded one at termination, containing a simple valvular apparatus. *Uterus* symmetrical. *Caudal alæ* large, supported by rays.

II. MARINE.

Spicules two, equal, solitary, or with one, two, or four accessory pieces. Occasionally a single supplemental organ in ventral region, above anus. Ventral excretory gland present in all (?). *Caudal sucker universal.*

* *Integument plain, or with longitudinal markings. Œsophagus embraced by glandular* (?) *ring.*

† *Spicules solitary, or with a single posterior median piece.*

14. **Symplocostoma.** *Pharyngeal cavity* elongated, oval, complex, crossed by lines or bars, and having a funnel-shaped body on its inferior aspect. *Ocelli* present or absent. *Spicules* long, solitary.

15. **Oncholaimus.** *Pharyngeal cavity* large, oval, provided with three tooth-like projections. *Ocelli* none (?). *Uterus* symmetrical or unsymmetrical. *Spicules* solitary, or with a single accessory piece.

16. **Enchelidium.** *Pharyngeal cavity* none (?). *Ocellus* mostly large and single. *Spicules* long, narrow, with or without a single median accessory portion.

[b]17. **Anticoma.** *Integument* having a row of opposite setæ on dorsal and ventral surfaces. *Ocelli* none. *Vaginal glands* two, equal. *Spicules* solitary. *Supplementary organ* small.

[b]18. **Phanoderma.** *Pharyngeal cavity* small. *Ocelli* distinct, lateral. *Spicules* long, solitary. *Supplementary organ* small.

†† *Spicules having two equal accessory pieces.*

[b]19. **Leptosomatum.** *Pharyngeal cavity* none. *Ocelli* distinct, dorsal, occasionally coalescing. *Excretory glandular organs two, lateral, opening on either side of head. Supplementary organ* a small sucker-like prominence.

[b]20. **Enoplus.** *Pharyngeal cavity* indistinct, surrounded by three separate *teeth* or jaws. *Ocelli* not distinct from surrounding pigment. *No œsophageal ring, and integument with delicate transverse as well as longitudinal striæ.*

[c]21. **Linhomoмius.** *Pharyngeal cavity* cup-shaped. *Œsophagus* enlarged behind pharynx and also at posterior extremity. *Œsophageal ring* (?). *Anal glands* large. *Accessory pieces* recurved.

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[a] All the animals belonging to the genera having this mark affixed to them have a modification of the ventral gland, and are endowed with a remarkable tenacity of life.

[b] The species belonging to the genera having this mark affixed to them are all distinguished by the males being provided with a supplementary organ.

[c] The males of the species belonging to these three genera present the common character of reflexed accessory pieces.

*** Integument with transverse striæ or dots. Œsophageal ring absent.*

† Ocelli absent.

‡ Uterus unsymmetrical.

22. TACHYHODITES. *Pharyngeal cavity* absent. *Two* peculiar colourless bodies on dorsal surface near anterior extremity. *Vaginal glands* wanting. *Accessory pieces* recurved.

23. THERISTUS. *Pharyngeal cavity* hemispherical. *Vaginal glands* two, unequal. *Accessory pieces* recurved.

24. SPHÆROLAIMUS. *Pharyngeal cavity* large, somewhat spherical. *Œsophageal canal* bounded by three longitudinal bands. *Vaginal gland* single, posterior. *Spicules* long, narrow, with a single posterior shield-shaped *accessory piece.*

‡‡ Uterus symmetrical.

25. COMESOMA. *Integument* having lateral circular depressions near head. *Pharyngeal cavity* very small. *Spicules* long, narrow, with or without a very small posterior *accessory piece.*

26. SPIRA. *Integument* having lateral, convex, circular prominences near head. *Pharyngeal cavity* none. *Œsophagus* having a slight rounded swelling posteriorly. *Spicules* stout, curved, with two *accessory pieces.*

27. ODONTOBIUS. *Pharyngeal cavity* none. *Teeth* doubtful. *Spicules* stout, curved, with two *accessory pieces.*

†† Ocelli present or absent.

28. CYATHOLAIMUS. *Integument* with transverse striæ or rows of dots. *Pharyngeal cavity* cup-shaped, with longitudinal markings. *Œsophagus* cylindrical. *Accessory pieces* strong, four, in two pairs. *Caudal sucker* elongated, cylindrical.

29. SPILOPHORA. *Integument* with transverse rows of dots or striæ. *Pharyngeal cavity* cup-shaped, with longitudinal markings, and three processes extending backwards. *Accessory pieces* two, rather indistinct. *Caudal sucker* elongated, cylindrical. *Œsophagus* having well-marked swelling posteriorly.

30. CHROMADORA. *Integument* with transverse and longitudinal striæ. *Pharyngeal cavity* rather indistinct, three cuneiform processes extending backwards and in contact. *Accessory pieces* two, strong, hooked. *Caudal sucker* elongated, pointed.

GENERA WHOSE CHARACTERS ARE INSUFFICIENTLY KNOWN.

31. AMBLYURA, Hemprich and Ehrenberg.
32. HEMIPSILUS, Quatrefages.
33. PHANOGLENE, Nordmann.
34. PONTONEMA, Leidy.
35. POTAMONEMA, Leidy.
36. NEMA, Leidy.
37. UROLABES, Carter.

SYNONYMS OF PREVIOUSLY DISCOVERED SPECIES.

Ascaris flustræ *, Dalyell	Phanoglene flustræ, XXXIII. 5 †.
Anguillula agrostidis, Steinbuch	Tylelenchus agrostidis, XII. 6.
vel	
——— *graminearum*, Diesing	
——— *dipsaci*, Kühn	Tylelenchus dipsaci, XII. 5.
——— *linea*, Grübe	Dorylaimus lineus, V. 12.
——— *longa*, Leidy	Trilobus longus, II. 3.
——— *mucronata*, Grübe	Rhabditis mucronata, XIII. 6.
——— *tritici*, Ehrenberg	Tylelenchus tritici, XII. 2.
Enoplus attenuatus, Diesing	Oncholaimus attenuatus, XV. 7.
——— *bioculatus*, M. Schultze	Chromadora bioculata, XXX. 8.
——— *coronatus*, Eberth	Leptosomatum coronatum, XIX. 6.
——— *crassiusculus*, Dujardin	Mononchus crassiusculus, III. 8.
——— *gracilis*, Eberth	Cyatholaimus gracilis, XXVIII. 6.
——— *ornatus*, Eberth	Symplocostoma ornatum, XIV. 4.
——— *rivalis*, Dujardin	Plectus rivalis, IX. 10.
——— *subrotundus*, Eberth	Enchelidium subrotundum, XVI. 4.
——— *tenuicollis*, Eberth	Symplocostoma tenuicolle, XIV. 2.
——— *tuberculatus*, Eberth	Phanoderma tuberculatum, XVIII. 3.
Lineola obtusicaudata, Kölliker	Phanoglene obtusicaudata, XXXIII. 4.
——— *rosea*, Kölliker	Phanoglene rosea, XXXIII. 3.
——— *Sieboldii*, Kölliker	Enoplus Sieboldii, XX. 14.
Oncholaimus fovearum, Dujardin	Mononchus fovearum, III. 6.
——— *muscorum*, Dujardin	Mononchus muscorum, III. 7.
Odontobius acuminatus, Eberth	Anticoma acuminata, XVII. 4.
Phanoglene bacillata, Eberth	Leptosomatum bacillatum, XIX. 4.
——— *longissima*, Eberth	Leptosomatum longissimum, XIX. 7.
——— *punctata*, Eberth	Leptosomatum punctatum, XIX. 2.
——— *subulata*, Eberth	Leptosomatum subulatum, XIX. 8.
Rhabditis aceti, Dujardin	Anguillula aceti, VI. 1.
——— *glutinis*, Dujardin	Anguillula glutinis, VI. 2.
——— *tritici*, Dujardin	Tylelenchus tritici, XII. 2.
Urolabes barbata, Carter	Symplocostoma barbatum, XIV. 5.
——— *ocellata*, Carter	Chromadora ocellata, XXX. 9.
——— *palustris*, Carter	Dorylaimus palustris, V. 11.
Vibrio anguillula marina, Müller	Pontonema marinum, XXXIII.
——— *tritici*, Bauer	Tylelenchus tritici, XII. 2.

* The first name, in italics, is that under which the species has been previously described, whilst the second, in ordinary roman type, is that under which it is described in the present memoir.

† The first figures refer to the number of the genus, the second to that of the species.

LAND AND FRESHWATER[1].

1. MONHYSTERA[2], Bastian.

GEN. CHAR. *Body* mostly tapering considerably posteriorly. *Caudal sucker* small, somewhat pointed. *Integument* unstriated; setæ very few; lateral circular mark on either side near anterior extremity. *Pharyngeal cavity* none. *Œsophagus* uniform, cylindrical. *Intestinal cells* not tessellated. *Vulva* about posterior third of body. *Uterus* unsymmetrical. *Viviparous or oviparous. Spicules* long and narrow. Accessory piece, when present, single, small. *Ocellus* single, often absent.

In all probability, the two species which I have named *M. disjuncta* and *M. ambigua* will hereafter be found to belong to a distinct genus; but, not having seen the females of either, I was unwilling to describe them apart, and have therefore placed them temporarily in that genus to which they seemed to be the most nearly allied.

1. M. STAGNALIS, n. sp. (Plate IX. figs. 9–11.)

Female, length $\frac{1}{15}''$, breadth $\frac{1}{250}''$.

External Characters.—Body opaque-white in part, tapering considerably at extremities, especially towards the posterior, which is long and filiform. Head truncated, having a circlet of 4–6 short setæ. Integument plain.

Œsophagus about $\frac{1}{8}$th of whole length. *Intestine* narrowed where encroached upon by genital tube, but widening considerably behind vulva. *Anus* $\frac{1}{111}''$ from posterior extremity. *Vulva* behind commencement of posterior third of body. *Viviparous*; young numerous. *Ocellus* bright red, on sheath of œsophagus.

Male, length $\frac{1}{22}''$, breadth $\frac{1}{454}''$. *Anus* $\frac{1}{142}''$ from posterior extremity. *Spicules* $\frac{1}{250}''$ long. *Accessory piece* small, somewhat triangular. *Spermatozoa* having slight vibratile movements, of an elongated oval form, $\frac{1}{5000}''$ long.

Hab. Mud from ponds, Falmouth and Easthampstead.

2. M. DISPAR, n. sp. (Plate IX. figs. 1, 2.)

Female, length $\frac{1}{23}''$, breadth $\frac{1}{555}''$.

External Characters.—Body scarcely tapering at all anteriorly, but abruptly behind vulva, and then gradually narrowing so as to terminate with a filiform extremity and minute pointed sucker. Head truncate, provided with 2–4 short setæ. Integument hyaline.

Œsophagus $\frac{1}{5}$th of total length. *Intestinal cells* containing rather large dark-coloured particles, having indistinctly tessellated arrangement. *Anus* $\frac{1}{143}''$ from posterior extremity. *Vulva* about commencement of posterior third of body.

Male, not seen.

Hab. In moss, Falmouth.

3. M. RIVULARIS, n. sp. (Plate IX. figs. 3, 4.)

Male, length $\frac{1}{28}''$, breadth $\frac{1}{666}''$.

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[1] Three exceptions to this,—*Rhabditis marina, Monhystera ambigua,* and *M. disjuncta* being marine, and found amongst the sand of tide-pools.

[2] *μόνος, single,* and *ὑστέρα, the uterus.*

External Characters.—Body tapering slightly anteriorly, but gradually to a point posteriorly. Head truncate; no setæ.

Œsophagus $\frac{1}{6}$th of total length. *Intestine* rather thinly covered with fat-particles. *Anus* $\frac{1}{200}''$ from posterior extremity. *Spicules* slightly enlarged at upper extremities, $\frac{1}{235}''$ long.

Female, not seen.

Hab. Sandy mud from stream, Falmouth.

4. M. LONGICAUDATA, n. sp. (Plate IX. figs. 5, 6.)

Female, length $\frac{1}{11}''$, breadth $\frac{1}{250}''$.

External Characters.—Body tapering slightly anteriorly, more considerably behind vulva, and terminating in a very long filiform extremity. Head truncate; no setæ.

Œsophagus about $\frac{1}{6}$th of total length. *Intestine* rather thinly covered with fat-particles, having indistinct tessellation. *Anus* $\frac{1}{71}''$ from posterior extremity. *Vulva* near middle of body. *Uterus* unsymmetrical.

Male, not seen.

Hab. Fine sedimentary sand, pond, Tunbridge Wells.

5. M. FILIFORMIS, n. sp. (Plate IX. figs. 7, 8.)

Female, length $\frac{1}{44}''$, breadth $\frac{1}{1111}''$.

External Characters.—Body long and narrow, scarcely tapering at all anteriorly, but narrowing behind vulva, and thence onwards, so as to terminate in a long filiform extremity. Head truncate; no setæ.

Œsophagus $\frac{1}{5}$th of total length. *Intestine* sparingly covered with fat-particles. *Anus* $\frac{1}{160}''$ from posterior extremity. *Vulva* considerably behind middle of body.

Male, not seen.

Hab. About liverwort, from pier of bridge just above water-level, river Blackwater.

6. M. DISJUNCTA, n. sp. (Plate IX. figs. 12, 13.)

Male, length $\frac{1}{20}''$, breadth $\frac{1}{435}''$.

External Characters.—Body tapering slightly anteriorly, and also gradually to a point posteriorly. Terminal sucker small; another large and prominent in the mid-ventral region, $\frac{1}{1000}''$ from posterior extremity. Head rounded; no setæ. Integument plain, having a circular depression on each side of head $\frac{1}{10000}''$ in diameter.

Pharyngeal cavity very small, conical. *Œsophagus* about $\frac{1}{9}$th of total length. *Intestine* having a sphincter with traces of a valvular apparatus occupying its commencement, which is devoid of granules; remaining portion covered by very large cells, apparently arranged in two rows. *Anus* $\frac{1}{312}''$ from posterior extremity. *Genital* duct opening separately $\frac{1}{2000}''$ above anus. *Spicules* at anal cleft, slightly curved, $\frac{1}{666}''$ in length, with two (?) small triangular accessory pieces. *Spermatozoa* linear, $\frac{1}{1000}''$ long, having slowly undulating movement.

Female, not seen.

Hab. Marine, in sand from tide-pool, Falmouth.

7. M. AMBIGUA, n. sp. (Plate IX. figs. 14, 15.)

Male, length $\frac{1}{17}''$, breadth $\frac{1}{400}''$.

External Characters.—Body narrowing gradually anteriorly, but tapering to a point abruptly behind orifice of genital tube. Sucker small, pointed. Head obtusely rounded, naked. Integument plain, having circular depressions on each side of head $\frac{1}{7000}''$ in diameter.

Œsophagus about $\frac{1}{8}$th of total length. *Intestine* having a kind of sphincter, with traces of a valvular apparatus at commencement; otherwise covered with very large cells appearing in two rows, and containing rather light-coloured particles. *Anus* $\frac{1}{250}''$ from posterior extremity. *Genital tube* containing very large and distinct granular cells, opening $\frac{1}{1000}''$ above anus. No *spicules* visible either there or at anal cleft.

Female, not seen.

Hab. Marine, in sand from tide-pool, Falmouth.

2. TRILOBUS[1], Bastian.

Anguillula, Leidy.

GEN. CHAR. *Body* tapering considerably posteriorly. *Caudal sucker* small. *Integument* plain, or with longitudinal striæ; setæ scarce. *Pharyngeal cavity* rather large, cup-shaped. *Teeth* none. *Œsophagus* cylindrical, having three lobes at termination. *Intestinal cells* having pale-coloured fat-particles, more or less distinctly tessellated. *Vulva* about middle of body. *Uterus* bifid, segments symmetrical. *Spicules* solitary. Males having well-developed ventral suckers. Movements moderately active, frequently coiling when touched.

1. T. GRACILIS, n. sp. (Plate IX. figs. 20–22.)

Female, length $\frac{1}{12}''$, breadth $\frac{1}{263}''$.

External Characters.—Body pale white, tapering slightly anteriorly, and gradually narrowing to a point posteriorly. Head bluntly rounded, provided with 4–6 stout, short setæ. Integument rather thick, but very transparent, with longitudinal striæ $\frac{1}{10000}''$ apart.

Pharyngeal cavity distinct, cup-shaped. *Œsophagus* $\frac{1}{6}$th of total length, having three oval lobes at termination, each about $\frac{1}{770}''$ long. *Intestinal cells* containing almost colourless fat-particles, not having distinct tessellation. *Anus* $\frac{1}{108}''$ from posterior extremity. *Vulva* rather anterior to middle of body; whole of uterus and ovaries very readily seen.

Male much smaller than female, length $\frac{1}{17}''$, breadth $\frac{1}{476}''$. *Anus* $\frac{1}{182}''$ from posterior extremity. *Spicules* solitary, segments narrow, nearly straight, about $\frac{1}{666}''$ in length. Transverse striæ, as well as longitudinal, for some distance above the genital cleft of male; also in mid-ventral region a row of six large sacculi (suckers), in two sets of three, each sacculus about $\frac{1}{2500}''$ deep.

Hab. About the roots of *Ruppia maritima* from brackish water, Falmouth.

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[1] τρεῖς, *three*, and λοβὸς, *a lobe*.

2. T. PELLUCIDUS, n. sp. (Plate IX. figs. 23, 24.)

Female, length $\frac{1}{9}''$, breadth $\frac{1}{222}''$.

External Characters.—Body white, tapering slightly anteriorly, more considerably posteriorly, where it terminates in a rather long filiform extremity, with a minute pointed sucker. Head truncate, provided with four short, spreading setæ. Integument transparent; no striæ visible.

Pharyngeal cavity cup-shaped. *Œsophagus* about $\frac{1}{6}$th of total length, having three pear-shaped lobes at termination, each about $\frac{1}{500}''$ long. *Intestine* well covered with light-coloured fat-particles tessellated in arrangement. *Anus* $\frac{1}{66}''$ from posterior extremity. *Vulva* slightly anterior to middle of body; genital organs very visible.

Male, not seen.

Hab. Mud from bottom of ponds, Falmouth. Has a habit of coiling itself into a circle when touched.

3. T. LONGUS.

Anguillula longa, Leidy, Proceed. of Acad. of Philad. v. p. 225.

" Body cylindrical, translucent, colourless. Mouth round; buccal cavity inverted, campanulate; œsophagus and intestine cylindrical, equal in diameter, the former $\frac{1}{25}''$ long.

" *Female,* 2 to 3 lines long; anteriorly $\frac{1}{333}''$ broad, middle $\frac{1}{285}''$. Tail narrow, acute, $\frac{1}{111}''$ to $\frac{1}{75}''$ long from anus.

" *Male,* $1\frac{1}{2}$ to 2 lines long, posteriorly dilated, obtusely rounded, curved, with three slight tubercular thickenings of the integument ventrally; $\frac{1}{285}''$ broad, at middle $\frac{1}{370}''$ broad. Penis a curved spiculum, $\frac{1}{280}''$ long.

" *Hab.* Found in very great abundance, wriggling about the surface of soft mud, in stagnant ditches in the neighbourhood of Philadelphia."

3. MONONCHUS[1], Bastian.

Oncholaimus, Dujardin; *Enoplus*?, Dujardin.

GEN. CHAR. *Body* tapering to a point posteriorly. *Caudal sucker* small, not pointed. *Integument* plain, or with longitudinal striæ; no setæ; papillæ present or absent around the mouth. *Pharyngeal cavity* large, oval, having one hook or tooth-like projection from the upper surface. *Œsophagus* cylindrical, canal indicated by three bright lines; transverse muscular fibres not distinct. *Intestine* well covered with hepatic cells; fat-particles light-coloured, having tessellated arrangement. *Vulva* about middle of body. *Uterus* bifid, segments symmetrical. *Spicules* ——? *Lateral canals* very indistinct, having a slightly cellular appearance. Movements active.

Dujardin appears to me to have included in his genus *Oncholaimus* two distinct types, which, as far as I have yet ascertained, are exclusively denizens of fresh and salt water respectively. Since he has described a marine representative as his typical species, I have retained the old generic name with a more limited definition for the animals of this type, whilst I have transferred the freshwater members to my new genus *Mononchus.* The species of this latter genus differ from those of the former in having one pharyngeal hook only instead of three; in having the head sometimes furnished with papillæ, but never, as far as I have seen, with setæ; by the different structure of the œsophagus, and absence of the peculiar œsophageal ring; and, lastly, by the comparatively undeveloped condition of the caudal sucker and its appendages.

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[1] *μόνος, single,* and *ὄγκος, a hook.*

The males of this genus must be either very minute or very scarce; for though I have seen nearly one hundred female representatives of the different species, I have never met with a single specimen of the opposite sex.

1. M. TRUNCATUS, n. sp. (Plate IX. figs. 25, 26.)

Female, length $\frac{1}{15}''$, breadth $\frac{1}{285}''$.

External Characters.—Body tapering slightly anteriorly, but more considerably posteriorly. Head truncate; no papillæ. Integument with longitudinal striæ, $\frac{1}{7500}''$ apart.

Pharyngeal cavity oval, $\frac{1}{588}''$ in length, with a single hook projecting from upper surface. *Œsophagus* about $\frac{1}{4}$th of total length. *Intestinal cells* with light-coloured particles, having distinctly tessellated arrangement. *Anus* $\frac{1}{110}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Lateral canals* broad, very indistinct, only recognizable behind intestine; no cells apparent—merely a few light-coloured scattered granules.

Male, not seen.

Hab. Small pool amidst decaying moss and liverwort, Falmouth.

2. M. PAPILLATUS, n. sp. (Plate IX. figs. 27, 28.)

Female, length $\frac{1}{11}''$, breadth $\frac{1}{250}''$.

External Characters.—Body opaque-white in colour, tapering slightly anteriorly, but gradually to a point posteriorly. Head truncate; mouth surrounded by four well-marked papillæ. Integument with longitudinal striæ, about $\frac{1}{10000}''$ apart.

Pharyngeal cavity a little removed from anterior extremity, proportionally rather small, $\frac{1}{714}''$ long; tooth single. *Œsophagus* $\frac{1}{4}$th of total length. *Intestinal cells* containing yellowish-coloured granules. *Anus* $\frac{1}{166}''$ from posterior extremity. *Vulva* at commencement of posterior third of body. *Uterus* bifid.

Male, not seen.

Hab. Between the sheaths of the leaves, at the lower part of culm of *Festuca elatior,* Broadmoor, Berks.

3. M. MACROSTOMA, n. sp. (Plate IX. figs. 29, 30.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{294}''$.

External Characters.—Body tapering very slightly towards head, more considerably posteriorly, where it is filiform for a short distance. Head obtusely rounded, with two papillæ, upper and lower. Integument with longitudinal striæ.

Pharyngeal cavity large, $\frac{1}{588}''$ long; hook single, $\frac{1}{1000}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length; very slightly increased in size posteriorly, where also there is a divergence of the bright lines representing the lumen. *Intestinal cells* well marked. *Anus* $\frac{1}{111}''$ from posterior extremity. *Vulva* at middle of body.

Male, not seen.

Hab. Small freshwater pool, in boggy ground, amidst decaying moss and liverwort, Falmouth.

4. M. TUNBRIDGENSIS, n. sp. (Plate IX. figs. 31, 32.)

Female, length $\frac{1}{23}''$, breadth $\frac{1}{416}''$.

External Characters.—Body scarcely tapering at all anteriorly, except quite at the extremity, opposite the pharyngeal cavity, where it becomes suddenly diminished in size; posteriorly it narrows rather abruptly behind anus, and then terminates in a curved filiform extremity. Head small, rounded; no papillæ. Integument having longitudinal striæ $\frac{1}{7500}''$ apart.

Pharyngeal cavity elongated, somewhat narrowed in the middle, $\frac{1}{1428}''$ long. *Œsophagus* $\frac{1}{5}$th of total length, uniform in size. *Intestinal cells* containing yellowish-coloured granules, and having a tessellated arrangement. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* slightly posterior to middle of body.

Male, not seen.

Hab. In fine sedimentary sand of small pond, Tunbridge Wells[1].

5. M. CRISTATUS, n. sp. (Plate IX. figs. 33, 34.)

Female (immature), length $\frac{1}{23}''$, breadth $\frac{1}{416}''$.

External Characters.—Body tapering very slightly anteriorly, but more considerably posterior to the anus, where it gradually narrows to a point, and is provided on the dorsal surface with an integumental prolongation or crista, whose greatest breadth is $\frac{1}{1666}''$. Head truncate, provided with a minute papilla above and below. Integumental striæ invisible.

Pharyngeal cavity large, oval, with one hook-like projection. *Œsophagus* between $\frac{1}{3}$rd and $\frac{1}{4}$th of total length, uniform in size. *Intestinal cells* not distinctly tessellated, containing small pale granules. *Anus* $\frac{1}{133}''$ from posterior extremity. *Vulva* considerably posterior to the middle of body.

Male, not seen.

Hab. In moss, Falmouth.

6. M. FOVEARUM.

Oncholaimus fovearum, Dujard. Hist. Nat. des Helminthes, p. 236.

"Corps trente à trente-trois fois aussi long que large; tête un peu anguleuse; cavité buccale oblongue, armée de deux ou trois pièces étroites, portant chacune (?) une forte dent en avant du milieu; œsophage long de $0^{mm}{\cdot}37$.

"*Femelle* longue de $2^{mm}{\cdot}5$, large de $0^{mm}{\cdot}075$, à queue amincie, assez longue, conservant une même longueur de $0^{mm}{\cdot}011$ dans sa dernière moitié, et terminée par une sorte de ventouse (?); anus à 0$^{\text{mm}}$·18 de l'extrémité; vulve située au milieu de la longueur; utérus divisé en deux branches opposées, contenant une seule série d'œufs.

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[1] This species was very abundant in the specimen of mud selected; and as it was the first example of one of the free Nematoids that was carefully submitted to examination by me, in May 1863, I have retained the name of the place where it was found as a specific appellation.

"Je l'ai trouvé à Rennes, au mois de Septembre, dans un fossé rempli par les eaux pluviales, et contenant des *Branchipus*, divers Entomostracés, des hydatides et des *Euglena*."

7. M. MUSCORUM.

Oncholaimus muscorum, Dujard. Hist. Nat. des Helminthes, p. 237.

"Corps trente-deux fois aussi long que large; tête rendue anguleuse par six ou huit papilles opposées, large de 0$^{\text{mm}}$·046; cavité buccale ovale, armée de trois pièces longitudinales arquées, dont une seule porte une forte dent en avant du milieu, tandis que les deux autres sont finement denticulées ou en peigne; œsophage long de 0$^{\text{mm}}$·55, large de 0$^{\text{mm}}$·04.

"*Femelle* longue de 2$^{\text{mm}}$·56, large de 0$^{\text{mm}}$·08; queue amincie, recourbée en crochet; anus à 0$^{\text{mm}}$·11 de l'extrémité; vulve saillante, située au tiers postérieur de la longueur; œufs longs de 0$^{\text{mm}}$·035.

"Il a été trouvé assez abondamment à Paris par mon ami M. Doyère, en 1839, dans les touffes de mousses (*Bryum*) des allées du Jardin des Plantes.

"J'ai depuis lors, en janvier 1844, trouvé à Rennes des Oncholaimes presque semblables dans l'intestin des *Gasterosteus lævis*, qui probablement les avaient avalés avec d'autres vers. Ils sont longs de 1$^{\text{mm}}$·6, large de 0$^{\text{mm}}$·09, avec la tête large de 0$^{\text{mm}}$·046, et la cavité buccale également longue de 0$^{\text{mm}}$·046."

8. M. CRASSIUSCULUS.

Enoplus crassiusculus, Dujardin, Hist. Nat. des Helminthes, p. 235.

"Corps long de 0$^{\text{mm}}$·60 à (?), large de 0$^{\text{mm}}$·026 à (?), vingt-trois fois seulement aussi long que large; tête large de 0$^{\text{mm}}$·015, hérissée de quelques soies roides; bouche montrant une armure interne; œsophage musculeux, épais, long de 0$^{\text{mm}}$·112, large de 0$^{\text{mm}}$·02.

"*Femelle* à queue allongée, amincie peu à peu; anus à 0$^{\text{mm}}$·12 de l'extrémité; vulve située vers le tiers postérieur.

"J'ai trouvé dans l'eau de la Vilaine, à Rennes, cet Helminthe, qui pourrait bien appartenir à un autre genre—à l'Oncholaime ou au Sclérostome, car il paraît avoir une cavité buccale distincte."

As it seems very doubtful to what genus this species really belongs, I have merely acted upon the suggestion of Dujardin, as expressed above, by transferring it to this group, in which are included the freshwater representatives of his genus *Oncholaimus*.

4. IRONUS[1], Bastian.

GEN. CHAR. *Body* long and narrow, tapering at extremities. *Caudal sucker* absent. *Integument* with delicate longitudinal markings; cephalic setæ present. *Pharyngeal cavity* long and narrow, having three small, moveable, rounded projections

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[1] From εἴρων, *a dissembler*, on account of its habits of straightening itself and remaining still for a short time, as if dead, when touched.

near commencement. *Œsophagus* cylindrical, canal indicated by three bright lines; transverse muscular fibres not distinct. *Intestine* moderately well covered with hepatic cells containing light-coloured fat-particles indistinctly aggregated. *Vulva* about the middle of the body. *Uterus* bifid, segments symmetrical. *Spicules* ——; *Lateral canals* —— ? Movements very sluggish.

I. IGNAVUS, n. sp. (Pl. IX. figs. 34 *a*, 34 *b*.)

Female, length $\frac{1}{13}''$, breadth $\frac{1}{555}''$.

External Characters.—Body long and slender, tapering very gradually at both extremities, till, at the posterior, it terminates in a long filiform portion. Head bluntly rounded, provided with a circle of four very short setæ. Integument having almost imperceptible longitudinal striæ, about $\frac{1}{30000}''$ apart.

Pharyngeal cavity long and narrow, having three small, rounded, valve-like plates near commencement. *Œsophagus* $\frac{1}{4}$th of total length. *Intestinal cells* containing light-coloured, non-tessellated particles. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* slightly anterior to the middle of body.

Male, not seen.

Hab. Stagnant water of Easthampstead Plain, amongst Diatomaceæ and decaying Algæ; also about the decaying submerged leaves of a species of *Myriophyllum* from the lake, Sandhurst.

5. DORYLAIMUS, Dujardin.

Urolabes, Carter; *Anguillula*, Grube.

GEN. CHAR. *Body* sometimes blunt and rounded, sometimes filiform posteriorly. *Caudal sucker* absent. *Integument* having longitudinal markings, more or less visible, and a series of minute pores on each side of body; setæ none; cephalic papillæ present or absent. *Pharynx* indistinct, but somewhat cup-shaped, having a long, horny and hollow exsertile spear projecting into and through it, which is renewed twice or oftener during the period of growth. *Œsophagus* having the posterior half, or one-third, of increased size; canal indicated by three bright lines; transverse muscular fibres not distinct. *Intestine* mostly well covered with hepatic cells containing fat-particles having a tessellated arrangement. *Vulva* about the middle of body. *Uterus* bifid, segments symmetrical. *Spicules* solitary, glaive-shaped; males having sometimes a variable number of linear ventral suckers in mid line above anal cleft, and also oblique markings of the integument. *Lateral canals* well developed and distinctly cellular.

The Nematoid (*D. stagnalis*) found by Dujardin at Rennes, within the stomachs of certain fish, appears to me identical with that form which I have met with so abundantly in mud from the bottom of freshwater ponds. Dujardin also appears to have found a marine representative of this genus, though I have searched for such in vain. Curiously enough, the form which Carter has taken as typical of his provisional genus *Urolabes* is undoubtedly a member of the genus *Dorylaimus*; and, from the absence of the caudal sucker amongst these, its habits would probably not be of the nature indicated by

Carter's generic name. Carter is inclined to believe that this *Urolabes palustris* may be the antecedent condition of the *Dracunculus*, or Guinea-worm, which is so prevalent as a parasite in the island of Bombay. But my investigations have almost convinced me that this is impossible, and principally for a reason which also occurred to Mr. Carter, but of the precise importance of which he does not seem to have been aware. He knew that the integument of the *Dracunculus* presented transverse striæ (most easily recognizable in the young), but could not succeed in demonstrating such striæ in *U. palustris*: to him its integument appeared plain. I have since ascertained that the integument in *Dorylaimus stagnalis* and others of the same genus not only has no transverse striæ, but is undoubtedly furnished with longitudinal ones[1]; and all my experience goes to prove that the nature of the integumental markings affords a constant character, not only of specific, but even of generic importance. Independently of this, there is the difficulty that no horny spear, such as exists in *U. palustris*, can be detected in the *Dracunculus*, and also the fact that nothing answering to the peculiar lateral sacculi discovered by myself[2] in the young Guinea-worms can be recognized in this, or has yet been found in any other species of Nematode, so far as I am aware, with the exception of *Dicelis filaria*, Dujardin. I may state, however, that from what I have seen of the anatomy of the *Dracunculus* and other members of the Nematoid order, I feel quite disposed to believe that its affinities are with these free Nematodes, and fully expect that one day this will be an established fact. I cannot but consider the step which Dr. Cobbold has taken in his recent work, of placing the Guinea-worm amongst the *Gordiidæ*, and constituting these a mere family of the order *Nematoidea*, as altogether a retrograde movement, and one almost in direct opposition to the existing state of our knowledge[3].

We are much indebted to Carter for his descriptions of the male and female genital organs of *U. palustris*, as well as for his account of the development of the spermatozoa. There appears to be no other representative of this genus *Dorylaimus* amongst the ten species described by him—five of which were marine, and five from fresh water.

In all the *Dorylaimi* examined, which had not yet attained their full development, I observed a second and somewhat larger spear a short distance behind the one *in situ*, and contained within the walls of the œsophagus. In due time this moves upwards in some obscure way, and finally displaces the other, just as the deciduous is replaced by the permanent tooth. It is not the whole of the rigid spear, however, that is renewed in this manner, but only what appears to be the anterior half of it.

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[1] It is from my observations on the anatomy of *D. stagnalis* that I have become perfectly convinced that the integument does present longitudinal, but no transverse markings. In this species I have frequently examined portions of integument freed from all other structures. But in the members of some other genera of free Nematoids not presenting transverse striæ, I am in many cases doubtful whether the integument is perfectly plain or has longitudinal markings—and this not only on account of the greater difficulty of recognizing such striæ, but also from the danger of confounding the appearance of the longitudinal muscles as seen through the integument with actual markings of this structure.

[2] Transactions of the Linnean Society, vol. xxiv. pl. 22. figs. 57–60.

[3] Nearly all the anatomical details of *Dracunculus*, so far as they are known, are in harmony with those of many typical Nematoids, whilst they differ considerably from those stated to obtain amongst the *Gordiidæ*. And if we may rely upon existing information, the difference as regards important anatomical characters is infinitely greater between these animals and the Nematoids generally than between any two of the families composing this latter order.

1. D. STAGNALIS, Dujardin. (Plate IX. figs. 35–37.)

Dujardin, Hist. des Helminthes, p. 231, pl. iii. fig. C.

Female. Length $\frac{1}{4}''$, breadth $\frac{1}{111}''$.

External Characters.—Body dark-coloured, tapering gradually anteriorly, but more abruptly posteriorly, where it terminates in a pointed filiform extremity. Head truncate; no papillæ. Integument thick, with longitudinal markings $\frac{1}{2000}''$ apart; lateral pores easily recognizable, and about $\frac{1}{1428}''$ apart.

Spear $\frac{1}{357}''$ long. *Œsophagus* $\frac{1}{5}$th of total length, posterior half enlarged. *Intestinal cells* having a tessellated arrangement, and containing dark-olive-coloured fat-particles. Posterior portion of intestine for about $\frac{1}{50}''$ narrower, and very scantily covered with cells and granules. *Anus* $\frac{1}{74}''$ from posterior extremity. *Vulva* slightly anterior to middle of body. *Ova* lying two or three abreast, within uterus.

Male. Length $\frac{1}{5}''$, breadth $\frac{1}{125}''$.

Œsophagus proportionally longer than in the female. *Anus* $\frac{1}{666}''$ from posterior extremity. *Spicules* solitary, $\frac{1}{250}''$ long. Oblique integumental striæ well-marked.

Hab. Mud from freshwater ponds, Falmouth; and New Cross, Kent.

Individuals of this species were found by Dujardin in the stomachs of the Carp (*Cyprinus carpio*) and of *Gasterosteus lævis*; which specimens, he conjectures, had been swallowed accidentally by these voracious fish.

2. D. CARTERI[1], n. sp. (Plate IX. figs. 38–40.)

Female. Length $\frac{1}{14}''$, breadth $\frac{1}{290}''$.

External Characters.—Body tapering towards either extremity, especially posteriorly, where it is acuminated. Head truncate; no papillæ. Integument thick.

Spear $\frac{1}{450}''$ long. *Œsophagus* about $\frac{1}{5}$th of total length. *Hepatic* or intestinal cells well marked. *Anus* $\frac{1}{455}''$ from posterior extremity. *Vulva* in the middle of body. *Ova* large.

Male, same size as female.

Œsophagus longer. *Spicules* $\frac{1}{500}''$ long by $\frac{1}{2000}''$ broad. Oblique markings of integument for some distance above spicules; also 8–11 minute *suckers* communicating with corresponding slanting channels through the integument, about $\frac{1}{1428}''$ apart, in the mid-ventral region.

Hab. Stagnant water, with decaying liverwort and moss: Falmouth.

3. D. OBTUSICAUDATUS, n. sp. (Plate IX. figs. 41, 42.)

Female. Length $\frac{1}{9}''$, breadth $\frac{1}{175}''$.

External Characters.—Body tapering considerably for some distance from anterior extremity, but not at all posteriorly, where it is blunt and rounded. Head truncate, marked off by a constriction from the rest of the body. Integument with longitudinal striæ $\frac{1}{10000}''$ apart.

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[1] Named after Mr. Carter, so as to connect his name with a species of that genus many of the details of whose anatomy were first carefully recorded by himself.

Spear $\frac{1}{400}''$ long. *Œsophagus* about $\frac{1}{5}$th of total length; anterior half narrow, posterior much wider. *Intestinal cells* not having tessellated arrangement, but well filled with rather small fat-particles. *Anus* $\frac{1}{500}''$ from posterior extremity. *Vulva* slightly posterior to middle of body.

Male not seen.

Hab. Amidst rich mould and decaying leaves, from a damp and shady wood, Falmouth.

4. D. TENUICAUDATUS, n. sp. (Plate IX. figs. 43, 44.)

Female. Length $\frac{1}{14}''$, breadth $\frac{1}{360}''$.

External Characters.—Body tapering very gradually anteriorly, but rapidly behind anal cleft, where it terminates in a long filiform extremity. Head truncate, furnished with two small papillæ. Integument with longitudinal markings.

Spear $\frac{1}{666}''$ long. *Œsophagus* about $\frac{1}{7}$th of total length, posterior half enlarged. *Intestinal cells* well marked. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* slightly posterior to the middle of body.

Male not seen.

Hab. Fine sandy mud from pond, Tunbridge Wells.

5. D. TRITICI, n. sp. (Plate X. figs. 45–47.)

Female. Length $\frac{1}{13}''$, breadth $\frac{1}{357}''$.

External Characters.—Body white, tapering very slightly anteriorly, and not at all posteriorly, where it is blunt and rounded. Head bluntly rounded, marked off by a constriction; no papillæ. Integumental markings not apparent.

Spear $\frac{1}{333}''$ long. *Œsophagus* rather less than $\frac{1}{3}$rd of total length, posterior half enlarged. *Intestinal cells* having a tessellated arrangement, and containing light-coloured fat-particles. *Anus* $\frac{1}{833}''$ from posterior extremity. *Vulva* slightly posterior to middle of body; segments of uterus very short, extending only about $\frac{1}{154}''$ on either side of vagina.

Male. Length $\frac{1}{17}''$, breadth $\frac{1}{500}''$.

Œsophagus much shorter than in female. *Anus* $\frac{1}{1000}''$ from posterior extremity. *Spicules* $\frac{1}{666}''$ long. *Suckers* 9, mid-ventral, the first being $\frac{1}{400}''$ above anus, and the others being equidistant and $\frac{1}{2000}''$ apart.

Hab. About the roots of wheat growing in a sandy soil, and also between the lower sheaths of its leaves: Broadmoor, Berks.

6. D. FILIFORMIS, n. sp. (Plate X. figs. 48, 49.)

Female. Length $\frac{1}{10}''$, breadth $\frac{1}{590}''$.

External Characters.—Body very long and slender, tapering only slightly anteriorly, but considerably posteriorly, where it terminates in a fine point. Head truncate; no papillæ. Integumental markings not visible.

Spear $\frac{1}{590}''$ long. *Œsophagus* $\frac{1}{6}$th of total length, posterior third enlarged. *Intes-*

tinal cells not distinctly tessellated, and containing light-coloured fat-particles. *Anus* $\frac{1}{133}''$ from posterior extremity. *Vulva* in the middle of body.

Male not seen.

Hab. With Diatomaceæ, on the decaying lower leaves of *Myriophyllum verticillatum* from pond, Bagshot.

7. D. POLYBLASTUS, n. sp. (Plate X. figs. 50, 51.)

Male. Length $\frac{1}{13}''$, breadth $\frac{1}{500}''$.

External Characters.—Body long and thread-like, tapering but very slightly at either extremity. Head rounded; no papillæ.

Spear $\frac{1}{1000}''$ long. *Œsophagus* $\frac{1}{7}$th of total length; posterior half enlarged. *Intestinal cells* moderately developed, and containing light-coloured fat-particles. *Anus* $\frac{1}{770}''$ from posterior extremity.

Spicules $\frac{1}{588}''$ long. *Suckers* 16–20, in mid-ventral region, commencing at $\frac{1}{417}''$ above anus, and occupying a space of about $\frac{1}{250}''$.

Female not seen.

Hab. With *Tylelenchus Davaineii,* from moss coating a large boulder in freshwater stream, Falmouth.

8. D. PAPILLATUS, n. sp. (Plate X. figs. 52, 53.)

Female. Length $\frac{1}{10}''$, breadth $\frac{1}{222}''$.

External Characters.—Body opaque-white, tapering gradually anteriorly, but not posteriorly, where it is blunt and rounded. Head truncate, provided with a coronet of six large papillæ. Integument with longitudinal striæ $\frac{1}{4000}''$ apart.

Spear $\frac{1}{500}''$ long. *Œsophagus* $\frac{1}{4}$th of total length, gradually widening posteriorly. *Intestinal cells* abundant, tessellated, containing light-olive-coloured particles. *Anus* $\frac{1}{666}''$ from posterior extremity. *Vulva* near the commencement of middle third of body. *Uterus* symmetrical. *Lateral cell-canals* very distinct, owing to their contained granules being of a light olive-colour.

Movements very sluggish.

Male not seen.

Hab. Between the lower sheaths of the leaves of the Giant Fescue (*Festuca elatior*), Broadmoor, Berks.

9. D. TORPIDUS, n. sp. (Plate X. figs. 54–56.)

Female. Length $\frac{1}{15}''$, breadth $\frac{1}{285}''$.

External Characters.—Body tapering gradually anteriorly, but more suddenly at posterior extremity, which is acuminated. Head truncate, provided with four small crucial papillæ. Integumental markings not apparent.

Spear $\frac{1}{400}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length; posterior half enlarged. *Intestinal cells* having a tessellated arrangement. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* slightly posterior to middle of body.

Male. Length $\frac{1}{17}''$, breadth $\frac{1}{500}''$. *Œsophagus* shorter. *Anus* $\frac{1}{400}''$ from posterior extremity. *Spicules* $\frac{1}{666}''$ long. *Suckers* none.

Hab. Same as last species.

10. D. INERS, n. sp. (Plate X. figs. 57–59.)

Female. Length $\frac{1}{13}''$, breadth $\frac{1}{285}''$.

External Characters.—Body tapering slightly anteriorly, but suddenly towards posterior extremity, which is acuminated. Head bluntly rounded. Integumental markings not visible.

Spear $\frac{1}{1000}''$ long. *Œsophagus* $\frac{1}{4}$th of total length, posterior third enlarged. *Intestinal cells* not well marked, and containing light-coloured granules. *Anus* $\frac{1}{333}''$ from posterior extremity. *Vulva* at middle of body.

Male. Length $\frac{1}{18}''$, breadth $\frac{1}{500}''$.

Œsophagus only half as long as that of female. *Anus* $\frac{1}{434}''$ from posterior extremity. *Spicules* $\frac{1}{588}''$ long. *Suckers* 5, mid-ventral, commencing about $\frac{1}{330}''$ above anus; distance between first two $\frac{1}{1000}''$, between the others gradually increasing.

Hab. Same as that of *D. polyblastus.*

11. D. PALUSTRIS.

Urolabes palustris, Carter, Ann. of Nat. Hist. 1859, 3 ser. vol. iv. p. 33, pl. ii. figs. 7, 9.

"*Female.* Length (max.) $\frac{1}{6}''$, breadth $\frac{1}{370}''$. Linear, cylindrical, smooth, white or colourless, unstriated transversely, gradually diminishing towards the head, which is obtuse and terminated by a distinct labiate portion, furnished with at least two, if not four, indistinct papillæ; diminishing abruptly towards the tail, which is attenuated and whip-like. *Mouth* in the centre of the anterior extremity. *Vulva* a little in front of the middle of the body. *Anus* at the root of the tail." . . . "*Œsophagus* commencing with a cup-like or buccal cavity, into the posterior part of which projects a sharp-pointed, horny, narrow tube (fig. 11 *d*), which is continued backwards in a straight line to the intestine, and is exsertile at the oral orifice."

"*Male* the same as the female, but smaller, and with the tail truncated almost close to the anus."

"*Hab.* Fresh water, in tanks and dirty drains wherever there is vegetable matter, mud, and putrescency, and in the gelatinous algæ during the 'rains:' Island of Bombay."

12. D. LINEA, Diesing.

Gordius lacteus, Müller?, Hist. Verm. terr. et fluv. i. ii. 32.

G. linea, Oken?, Lehrb. d. Naturg. Zool. i. Abtheil. 192.

Anguillula linea, Grube, Wiegmann's Arch., 1849, i. 367–368, tab. vii. figs. 15–17; Diesing, Syst. Helminth. p. 557.

Dorylaimus linea, Diesing, Sitzungsber. der kais. Akad. der Wissen. xlii. Bd. p. 626.

"*Corpus* intestino nigro percursum utrinque parum attenuatum, antice truncatum, margine paulo incrassato. *Cauda* subulata, fere $\frac{1}{12}$ longitudinis corporis. *Apertura genitalis* feminea subcentralis supera. Longit. fem. 2–8‴, crassit. ad $\frac{1}{7}$‴.

"Œsophagus postice bulbosus, denticulo solummodo retracto viso.

"*Hab.* In fondo aquarum cum *Sænuride variegata,* haud raro Dorpati."—*Grube.*

13. D. **marinus**, Dujardin.

Hist. Nat. des Helminth. p. 231, pl. iii. fig. D.

"Corps blanc, long de 3^{mm}, large de $0^{mm}\cdot125$; rapport de la longueur à la largeur 24; stylet protractile, continué par un long tube flexible et par le canal triquètre de l'œsophage; tégument lisse.

"*Femelle* ayant la queue longue, effilée, la vulve au milieu de la longueur, et les œufs oblongs, longs de $0^{mm}\cdot07$; larges de $0^{mm}\cdot027$.

"Je l'ai trouvé dans l'eau de mer, parmi les algues, à l'Orient."

6. ANGUILLULA, Ehrenberg.

Vibrio, Müller; *Ascaris*, Goeze; *Rhabditis*, Dujardin.

Gen. Char. Body long, narrow, and tapering at extremities. *Caudal sucker* absent. *Integument* thin, presenting neither transverse nor longitudinal markings; setæ none (?); papillæ none (?). *Pharyngeal cavity* very minute. *Œsophagus* cylindrical, with rounded swelling posteriorly containing a simple horny valvular apparatus. *Intestine* sparingly covered with large colourless granules, presenting no appearance of tessellation; distinct cells not recognizable. *Vulva* posterior to the middle of body. *Uterus* unsymmetrical. *Oviparous* or *viviparous*. *Spicules* long, narrow, curved. *Accessory piece* single, posterior, somewhat fan-shaped. *Ventral gland* wanting. *Floating gland-cells* abundant. *Lateral canals* not recognizable.

Movements active.

Under the old imperfectly defined genus *Anguillula* have been ranged, from time to time by various observers, the most heterogeneous types; but the name has become so familiar, and to some extent distinctive of these free Nematoids, that I have thought it better to retain it with a limited signification, than to cast it aside altogether. This I have accordingly done, taking as a type *Anguillula aceti*, since this appears to have been so regarded by Ehrenberg, and modifying the general terms in which he formerly described the genus by the substitution of more exact statements, founded on the anatomical characters of that species[1]. This will undoubtedly exclude many of the other forms hitherto located in this genus, and amongst them the so-called *Anguillula tritici*, which I have now placed, with other allied species, in the new genus *Tylelenchus*. Several of the species also that I have (from ignorance of their real characters) still retained under this generic name will, I have little doubt, have to be weeded out by subsequent observers, and transferred to other genera as more precise information is obtained concerning their anatomy.

I have already expressed my reluctance to assent to Diesing's arrangement when he places in this genus many parasitic forms found in beetles, myriapods, and other animals. Some of these species, which, in his 'Systema Helminthum,' Diesing had included in the genus *Anguillula*, he has now, in his more recent 'Revision der Nematoden,' transferred to the genus *Isacis* of Lespés; whilst he includes, as subsections of the former genus, certain other of these parasitic forms, mostly discovered by Dr. Leidy, of Philadelphia, and placed by him, rightly enough, in distinct genera—*Streptostoma*, *Thelastoma*, and *Hystrignathus*.

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[1] I am indebted to the kindness of Dr. Davaine for the opportunity I have had of examining these animals myself. Before obtaining a supply from him, I had in vain endeavoured to procure them. They are much less frequent than is generally imagined, at all events in England; and this may be due in great measure to the adulteration of our vinegar with sulphuric acid.

For many of the descriptions and references concerning old species placed in this and other genera I have freely availed myself of Diesing's admirable work.

1. A. ACETI, Ehrenberg. (Pl. X. figs. 59*a*–59*c*.)

Borellus, Obs. Microscop. Centur. 7, 1656.
Power, Microsc. Obs. 38.
Hook, Microsc. i. 2, tab. i.
Joblot, Obs. Micr. i. 2, tab. i.
Leeuwenhoek, Phil. Trans. 1676, p. 656.
Cellius, apud Bakerum, ii. 250 (vivipara).
Backer, Micr. tab. x. 8, 9; Micr. Expl. 81, tab. v. 10.
Fränkische Samml. iv. 277, figs. *g*–*o*.
Goeze, Naturf. i. St. 1–53, et xviii. St. 38, tab. iii. 12–19.—Idem in Bonnet's Organis. Körp. 59.
Spallanzani, Opus. Phys. i. 83.
Rozier, Anguille du Vinaigre, Obs. 1775, Mars, tab. i. fig. 5; 1776, Janv., 51, et Mars, 382.
Essig-Aelchen, Martini, Allgem. Gesch. d. Nat. i. 412; Beschäft. Berlin. Gesellsch. i. 342.
Chaos redivivum, Linné, Syst. Nat. 1326 (aceti).
Vibrio anguillula, *a. Anguillula aceti*, Müller, Anim. Infus. 63, tab. ix. 1–11.—Idem, in Naturf. xix. St. 162.
Vibrio aceti, Bory, in Encycl. Méth. 1824, p. 788, tab. iv. 16.—Dugès, in Ann. des Sc. Nat. ix. 225, tab. xlvii. 2, 19, 32 ♀, et xlviii. 44–50 ♂, 51 (in copulâ).—De Blainville, in Dict. des Sc. Nat. lvii. 573 et lviii. 70.
Rhabditis aceti, Dujardin, Hist. Nat. des Helminthes, 242.
Czernay, Monogr. d. Essigälch. mit kol. Kpft. Moskau, 1849.—Idem, Bullet. de Moscou, xxii. (1849) 232–256, tab. vi. (cum anatom. et de evolut.).
Anguillula aceti, Ehrenberg, Infusionsth. 82.
Leidy, in Proc. Acad. Philad. viii. (1856) 48.
Hogg, Pop. Sc. Review, Jan. 1863, p. 216, pl. x.
Diesing, Syst. Helminth. ii. p. 128; et Sitzungsb. ais. Akad., Bd. xlii., No. 28, p. 627.

Female (size very variable). Length $\frac{1}{13}''$, breadth $\frac{1}{555}''$.

External Characters.—Body white, much obscured by colourless granules within integument; long and narrow, tapering very much posteriorly, and terminating in a long pointed extremity. Head rounded, unarmed. Integument thin, showing no striæ.

Pharyngeal cavity very minute, cup-shaped. *Œsophagus* $\frac{1}{9}$th of total length, having a rounded swelling at termination, containing valvular apparatus. *Intestine* covered with coarse colourless granules; no sort of tessellation. *Anus* $\frac{1}{80}''$ from posterior extremity. *Vulva* somewhat posterior to middle of body. *Uterus* unsymmetrical. Small *floating gland-cells* numerous in cavity of body.

Male. Length $\frac{1}{21}''$, breadth $\frac{1}{850}''$.

Œsophagus $\frac{1}{7}$th of total length. *Anus* $\frac{1}{133}''$ from posterior extremity. *Spicules* narrow, having a double curve, $\frac{1}{714}''$ long. *Accessory piece* about $\frac{1}{3}$rd as long as spicules, rather thick externally, but expanding inwards into a thinner fan-shaped portion.

"*Hab.* In fæcibus aceti (*Borellus, Müller,* &c.); in aceto communi cerevisiæ et vini, in aqua cum farina, in aqua cocta, et in fæcibus cerevisiæ, Moscoviæ (*Czernay*); in aceto e pomis parato, frequenter Philadelphiæ (*Leidy*)."

"Nota 1. Larvas muscæ cujusdam (*Mosilli cellarii*?) in aceto obvias cum hac specie confundit Spallanzani (Microsc. Beobacht. 176).

"Nota 2. Probabiliter e *Mosilli cellarii* intestinis in acetum translata."—Diesing.

If the drawings are accurate (Pop. Sc. Rev. Jan. 1863) of the animal discovered, by Mr. Jabez Hogg, about portions of the common truffle left for some days moistened with vinegar, I am rather inclined to believe that this will prove to be a distinct species, and not the real *A. aceti,* since it differs in several respects, more especially as regards the male spicules, from the animals examined by myself, concerning which there can be little doubt, seeing that they swarm in a specimen of pure vinegar, kindly sent to me by M. Davaine.

2. A. GLUTINIS, Ehrenberg.

Aale im Kleister, Ledermüller, Microsc. 33, tab. xvii. 1.—Buffon, Allgem. Hist. d. Natur, i. 2. 154.—Martini, Allgem. Gesch. d. Natur, i. 412.—Backer, Microsc. Expl. 82.—Schrank, Beitr. 109.—Leske, Naturg. i. 559.—Goeze, in Naturf. ix. St. 177, tab. iv. 17–19.

Chaos redivivum, Linné, Syst. Nat. 1326 (in glutine bibliopegorum).

Anguille de la Colle, Rozier, Obs. 1775, Mars, tab. i. 4, et 1776, Mars, 383.

Vibrio anguillula, β. Anguillula glutinis, Müller, Anim. Infus. 64, tab. ix. 1–4.

Vibrio glutinis, Bory, in Encycl. Méth. 1824, p. 780.—Dugès, in Annal. des Sc. Nat. ix. 225, tab. xlvii. 4, 10, 11, 20, 21 ♀, tab. xlvii. 22–25 bis, 26, 27, 30, 31, 33, 37, 38, 40, 41 ♀, 42, 43 ♂.—Blainville, in Dict. des Sc. Nat. xlvii. 53, et xlviii. 71.

Anguillula glutinis, Ehrenberg, Infusionsth. 82.

Rhabditis glutinis, Dujardin, Hist. Nat. des Helminthes, 243.—Leidy, in Proceed. Acad. Philad. viii. (1856) 49.

"Corps filiforme, assez épais, long de 1$^{\text{mm}}$·68; vingt fois environ aussi long que large, amincie en arrière et terminé par une pointe fine allongée; vulve située au tiers postérieur; œufs grands (de 0$^{\text{mm}}$·09) à coque membraneuse et contenant un embryon replié."—*Dujardin.*

"*Hab.* In glutine farinæ (*Baker, Müller,* &c.); in glutine tritici, secalis, tragacanthi, etc., frequenter Philadelphiæ (*Leidy*)."—*Diesing.*

In the paper before alluded to, Mr. Hogg seems to doubt the fact of any specific difference existing between this form and *Anguillula aceti*; but, from the descriptions of Dujardin, there appears to be a great discrepancy in the comparative dimensions of the two. Thus, speaking of *Anguillula aceti,* he reports it as, "trente à quarante-cinq fois aussi long que large," and so making the body much narrower than in *A. glutinis.* M. Davaine believes them to be distinct species, and says, in a letter lately received, "D'après quelques recherches que j'ai faites, il y a quelques années, je pense que les vers de la colle de pâte viennent de la terre, où elles vivent normalement dans les grains ou dans les racines qui contiennent de la fécule."

All my attempts to procure these animals in ordinary wheaten paste have been unsuccessful, though I have taken every precaution to ensure the purity of the flour.

3. A. FLUVIATILIS, Hemprich & Ehrenberg.

Ferskoands Aal, Strackker, in Nye Samml. of Dansk. Vid. Selsk. Skr. iii. D. 33.

? *Corculum vermiculo simile*, Linné, Amœn. Acad. (mundus invis.).

Vibrio anguillula, γ. *Anguillula fluviatilis*, Müller, Anim. Infusor. 65. tab. ix. 5–8. (Reliqua synon. Mülleri vel incerta, vel ad Anguillulam tritici aut Lumbrici pertinent.)

Vibrio fluviatilis, Bory, in Encycl. Méth. 1824, p. 777, tab. iv. 20–23.—Idem in Dict. Class. d'Hist. Nat. xvi. 586 (les Oxyurides), tab. v. A, 39.—Blainville in Dict. des Sc. Nat. lvii. 537, et lviii. 71.

Anguillula fluviatilis, Hemprich et Ehrenberg, Symb. Phys. Phytoz. Entoz. tab. ii. 8 et 13 (*libyca*).—Ehrenberg, Organ. Syst. u. geogr. Verb. d. Infusionsth. 1830, pp. 10, 15, 68, 105, tab. vii. 5 ; ejus Infusionsth. 82.—Dujardin, Hist. Nat. des Helminthes, 244.—Diesing, Syst. Helminth. ii. 130.

"*Cauda* recta brevi conica, subulata, baseos crassitie triplo quadruplove longior. Longit. $\frac{1}{8}$–$\frac{1}{3}'''$."—*Diesing.*

"Corpus subtilissime transverse striolatum, subannulatum. Tubus cibarius hinc ore illinc ano terminatus, simplex, cum strictura cardiaca. Os terminale, anus ad caudæ basim lateralis. Feminarum apertura genitalis in medio corpore. Uterus bicornis. Ova ovata. Fœtus maturus bis complicatus. Feminæ maribus majores. Maris penis simplex nec vaginatus. Ita in speciminibus Berolinensibus."—*Ehrenberg*, Symb. Phys. *l. c.*

"*Hab.* In aqua dulci in Dania (*O. F. Müller*).—Inter Confervas, in aqua Oaseos Jovis Hammonis Siwæ, nec non pagi Tor in Arabia.—In Sibiria prope Tobolsk, in montibus altaicis prope Semimogorsk et prope Berolinum (*Ehrenberg*)."—*Diesing.*

The few definite characters given above, such as "corpus subtilissime transverse striolatum" and "uterus bicornis," seem pretty positively to indicate that this species does not in reality belong to the genus *Anguillula.* Any free Nematodes other than the "paste-" or "vinegar-eels," or the *Tylelenchus tritici,* which have been accidentally met with or referred to by most English writers hitherto, have been provided with the convenient name of *Anguillula fluviatilis*; so that the altogether doubtful animal to which this cognomen rightly belongs has been invested with a pseudo-popularity for which, in all probability, it could make but little valid claim. It may perhaps belong to the genus *Plectus*, judging from the characters above mentioned, as well as the abundance and wide distribution of the animals of this type.

4. A. INFLEXA, Hemprich & Ehrenberg.

Anguillula inflexa, Hemprich et Ehrenberg, Symb. Phys. Phytoz. Entoz. tab. i. 12 (*Vibrio fluviatilis niloticus*).—Dujardin, Hist. Nat. des Helminthes, 244.—Diesing, Syst. Helminth. ii. 131.

"*Cauda* longiore subulata, maris inflexa, baseos crassitie plus decuplo longiore, corporis fere octavam partem æquante. Longit. mar. $\frac{1}{8}$–$\frac{1}{4}'''$, crassit. $\frac{1}{64}''$; fem. $\frac{1}{4}$–$1'''$, crassit. $\frac{1}{38}'''$.

"*Hab.* Inter Confervas aquæ Nili in provincia Dongola Nubiæ eandem formam cepisse monet cel. Ehrenberg, quam serius in aqua salsa prope Petropawlofsk in Sibiria et prope Berolinum reperiit."

5. A. COLUBER, Hemprich & Ehrenberg.

Vibrio coluber, Müller, Anim. Infus. 62, tab. viii. 16–18.

Anguillula coluber, Hemprich & Ehrenberg, Symb. Phys. Phytoz. Entoz.—Dujardin, Hist. Nat. des Helm. 244.—Diesing, Syst. Helminth. ii. 131.

"*Cauda* inflexa, longissima, corporis quarta parte longiore. Longit. . . . .

"*Hab.* In aqua fluviatili in Dania, rarissime (*O. F. Müller*); prope Berolinum (*Ehrenberg*)."

6. A. RECTICAUDA, Hemprich & Ehrenberg.

Anguillula recticauda, Hemprich & Ehrenberg, Symb. Phys. Phytoz. Entoz.—Dujardin, Hist. Nat. des Helm. 244.—Diesing, Syst. Helminth. ii. 131.

"Cauda recta, longissima, corporis quintam sextamve partem æquans. Longit. . . ."

"*Hab.* In aqua prope Berolinum (*Ehrenberg*)."

"Celeb. Ehrenberg individua cutem exuere vidit, quod in *Vibrione anguillula* pariter observavisse Müller et Roffredi asserunt."

7. A. DONGOLANA, Hemprich & Ehrenberg.

Anguillula dongolana, Hemprich & Ehrenberg, Symb. Phys. Phytoz. Entoz. tab. i. 13 (*Vibrio dongolanus*).—Dujardin, Hist. Nat. des Helminthes, 244.—Diesing, Syst. Helminth. ii. 131.

"*Corpus* recurvatum. *Cauda* brevissima, obtusissima, rotundata, parum longior quam crassa, fere nulla. Longit. $\frac{1}{4}'''$."

"*Hab.* Inter Confervas in aqua Nili Dongolæ (*Hemp. et Ehren.*)."

8. A. BRASSICÆ, Grübe.

Anguillula Brassicæ, nov. sp.?, Grübe, in Wiegmann's Arch. 1849, i. 365–367, tab. vii. 18–20.—Diesing, Syst. Helminth. ii. 557.

"*Extremitate* corporis antica vix attenuata obtusa rotundata, haud crenata, postica sensim subtiliter acuminata, cauda fœminæ fere $\frac{1}{6}$, maris $\frac{1}{4}$ corporis æquante pauloque incurva, œsophago postice haud incrassato, vulva pæne in medio corpore sita. Longit. $\frac{1}{25}'''$ (?), crassit. $\frac{1}{70}'''$."

"*Hab.* In brassica depravata, Novembri ad Martium usque, Berolini (*Münter* et *Oschatz*)."

"*Anguillulæ inflexæ* et *A. recticaudæ*, no. 4. et 6. affinis."

9. A. MINISTERIALIS, Diesing.

Vibrio glutinis, Humboldt, Ueber die gereizte Musk. u. Nervenf. i. 179.

Vibrio ministerialis, Bory, in Encycl. Méth. 1824, p. 778.—Diesing, Syst. Helminth. ii. 136.

"*Corpus* pellucidum. *Os* dilatatum, subhians; cauda acutissima. Longit. ad $\frac{3}{4}'''$."

"*Hab.* In fungis deliquescentibus (*Humboldt* et *Bory*)."

10. A. FÆCULORUM, Diesing.

Rhabditis feculorum, Guérin-Méneville, in Acad. des Sc. Nat. Paris, 1845; Vers. in Oesterreich, K.-k. Wiener Zeitung, 1845, 7 Nov. 2362.—Idem in Comptes Rendus, xxi. (1845) 878.—Froriep, Neue Notiz. xxxvi. 186.—Diesing, Syst. Helminth. ii. 136 et 556.

"*Hab.* In Solani tuberibus depravatis (*Guérin-Méneville*)."

11. A. FOSSULARIS, Leidy.

Proc. of Acad. of Philad. v. 226.

"♀ Body cylindrical, anteriorly narrowed, truncated. Mouth round, surrounded by a

prominent circular lip; buccal apparatus none; pharynx short; œsophagus long, clavate or fusiform, slightly tortuous; intestine cylindrical, brown in colour; rectum distinct, cylindrical, colourless. Tail acute. Ovary double. Generative aperture anterior to the middle."

"Length 2 to $2\frac{1}{2}$ lines, breadth $\frac{1}{250}''$, tail $\frac{1}{80}''$ long from anus. Œsophagus $\frac{1}{28}''$ long; $\frac{1}{1333}''$ broad at commencement, $\frac{1}{400}''$ at termination. Intestine $\frac{1}{4750}''$ broad. Rectum $\frac{1}{75}''$ long."

"*Hab.* Stagnant ponds and rain-puddles in the suburbs of Philadelphia."

12. A. **ECAUDIS**, Ehrenberg.

Monatsber. d. Berlin. Akad. 1853 (solum nomen), et ibid. 1855, p. 226.—Diesing, Sitzungsb. der Kais. Akad. Bd. xlii. (1861) 629.

"*Hab.* In terra muscorum Montis Rosæ (*Schlagintweit* et *Ehrenberg*)."

13. A. **LONGICAUDA**, Ehrenberg.

Monatsber. d. Berlin. Akad. 1853 (solum nomen), et ibid. 1855, p. 226; ejus Mikrogeologie, 1854, tab. xxxv. B. A. iii. F. (sine descript.).—Diesing, Sitzungsb. der Kais. Akad. Bd. xlii. (1861) 629.

"*Hab.* In terra muscorum, Weissthorpass ad montem Rosæ, in altitudine 11,138′ (*Schlagintweit* et *Ehrenberg*)."

14. A. **RANÆ TEMPORARIÆ**, Perty.

Kleinste Lebensformen, 156.

"*Hab.* *Rana temporaria*, in tractu intestinali cum *Opalinis*, Bernæ (*Perty*)."

"Sine dubio Anguillulæ cum aqua haustæ vel cum cibo in intestinum translatæ."

7. TRIPYLA[1], Bastian.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* large, well developed. *Integument* thick, having well-marked transverse striæ, with lateral and ventral pores; setæ none (?); cephalic papillæ present or absent. *Pharyngeal cavity* none. *Œsophagus* cylindrical, distinctly muscular; posterior part separated by a constriction, but not containing any valvular apparatus. *Intestine* rather sparsely covered with coarse granules, their arrangement in cells not being visible. *Vulva* at about the middle of body. *Uterus* bifid, segments symmetrical. *Spicules* of an elongated cuneiform shape. *Accessory piece* posterior, very small. *Lateral canals* indistinct, having a faintly granular appearance. No regular *ventral duct*, but three large integumental canals in same region, close to anterior extremity.

Movements active, often forming into a coil when touched.

1. T. **GLOMERANS**, n. sp. (Pl. IX. figs. 16, 17.)

Male, length $\frac{1}{11}''$, breadth $\frac{1}{256}''$.

External Characters.—Body white, cylindrical, tapering slightly forward, but more backwards, where it gradually narrows to the well-developed sucker. Head bluntly rounded; no papillæ. Integument thick; transverse striæ very distinct, $\frac{1}{7506}''$ apart, having lateral pores and three larger equidistant channels opening through anterior part of ventral region.

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[1] Τρεῖς, *three*, and πύλη, an orifice, in allusion to the three well-marked integumental openings.

Œsophagus about $\frac{1}{5}$th of total length; constricted portion $\frac{1}{1428}''$ long. *Intestine* sparsely covered with light-coloured fat-particles. *Anus* $\frac{1}{69}''$ from posterior extremity. *Spicules* cuneiform, slightly curved, $\frac{1}{333}''$ long. *Accessory piece* small and indistinct, somewhat triangular.

Female, not seen.

Hab. Mud from freshwater ponds, Falmouth; and Easthampstead, Berks.

2. T. SALSA, n. sp. (Plate IX. figs. 18, 19.)

Female, length $\frac{1}{8}''$, breadth $\frac{1}{208}'$.

External Characters.—Body cylindrical, tapering much the same as last. Head more rounded, provided with two papillæ, lateral (?). Integument thinner; transverse striæ not so well marked.

Œsophagus $\frac{1}{6}$th of total length; constricted portion large, $\frac{1}{833}''$ long. *Intestine* covered with rather large, light-coloured fat-particles. *Anus* $\frac{1}{65}''$ from posterior extremity. *Vulva* posterior to the middle of body. *Uterus* bifid. *Lateral canals* indistinct, $\frac{1}{1000}''$ broad.

Male, not seen.

Hab. About the roots of *Rüppia maritima*, brackish water, Swanpool, Falmouth.

8. DIPLOGASTER, Max Schultze.

GEN. CHAR.—*Body* tapering at extremities, especially at posterior. *Caudal sucker* very small, scarcely recognizable. *Integument* having longitudinal and also delicate transverse markings; setæ none (?); papillæ none (?); small lateral cervical markings. *Pharynx* cup-shaped, having two horny valvular plates at the bottom. *Œsophagus* having a well-marked muscular swelling about its middle; canal of anterior half indicated by three bright lines; not so, however, posterior to muscular swelling. *Intestine* moderately covered with fat-particles, having a more or less tessellated appearance. *Vulva* about the middle of body. *Uterus* bifid, segments symmetrical. *Spicules* two, curved, barbed. *Accessory piece* single, posterior, easily recognizable. *Ventral excretory gland* wanting. *Lateral canals* . . .

Movements very active.

1. D. FICTOR, n. sp. (Plate X. figs. 71–73.)

Female, length $\frac{1}{15}''$, breadth $\frac{1}{500}''$.

External Characters.—Body white, slender, tapering very slightly anteriorly, but considerably posteriorly, where it gradually tapers to a fine point; sucker not recognizable. Head truncate, unarmed. Integument with longitudinal striæ $\frac{1}{10000}''$ apart, and almost imperceptible transverse striæ $\frac{1}{20000}''$ apart.

Pharyngeal cavity $\frac{1}{3333}''$ deep. *Œsophagus* $\frac{1}{6}$–$\frac{1}{7}$th of total length, swelling in the middle, $\frac{1}{714}''$ long. *Intestinal cells* containing a moderate number of light-coloured particles, tessellated. *Anus* $\frac{1}{125}''$ from posterior extremity. *Vulva* slightly anterior to middle of body.

Male rather shorter, more slender, and transparent breadth being $\frac{1}{833}''$. *Anus* $\frac{1}{143}''$ from posterior extremity. *Spicules* curved, $\frac{1}{1111}''$ long. *Accessory portion* well marked, $\frac{1}{1666}''$ long.

Hab. With Diatomaceæ from the decaying lower leaves of *Myriophyllum verticillatum*, pond, Bagshot.

Has a habit, when touched, of straightening itself, and remaining perfectly still for a few seconds.

2. D. ALBUS, n. sp. (Plate X. figs. 74, 75.)

Female, length $\frac{1}{42}''$, breadth $\frac{1}{555}''$.

External Characters.—Body white, rather stout, tapering very slightly forwards, but considerably backwards, where it terminates in a short filiform extremity. Head bluntly rounded. Integument having longitudinal and transverse striæ.

Pharyngeal cavity large, cup-shaped, with valvular plates at bottom. *Œsophagus* $\frac{1}{6}$th of total length, having the usual median swelling $\frac{1}{1250}''$ long. *Intestine* slightly covered with light-coloured fat-particles. *Anus* $\frac{1}{285}''$ from posterior extremity. *Vulva* in middle of body.

Male, not seen.

Hab. About rootlets of wheat from sandy soil, Broadmoor, Berks.

3. D. FILIFORMIS, n. sp. (Plate X. figs. 76–78.)

Female, length $\frac{1}{41}''$, breadth $\frac{1}{1000}''$.

External Characters.—Body white and very slender, tapering very slightly anteriorly, but very considerably behind, where it terminates in a long filiform extremity. Integument with longitudinal striæ $\frac{1}{10000}''$, and transverse $\frac{1}{20000}''$ apart.

Pharyngeal cavity cup-shaped, with horny plates at bottom. *Œsophagus* about $\frac{1}{6}$th of total length, with usual swelling of mid portion. *Intestine* covered sparingly with light-coloured granules. *Anus* $\frac{1}{222}''$ from posterior extremity. *Vulva* at middle of body.

Male, length $\frac{1}{44}''$, breadth $\frac{1}{1250}''$.

Anus $\frac{1}{180}''$ from posterior extremity, which is longer than in female. *Spicules* could not be detected, though the *genital tube* could be readily seen in front of the anus.

Hab. Same as last.

I could detect no sucker with the microscope, though I feel confident that such a structure, however minute, must exist, since I have seen the male of this species swaying violently about in all directions, the extremely fine extremity of thread-like tail only remaining in a fixed position.

4. D. MICANS, Max Schultze.

V. Carus's Icones Zootomicæ, tab. viii. 1.

No description or reference.

Hab. Unknown.

9. PLECTUS[1], Bastian.

Enoplus?, Dujardin.

GEN. CHAR. *Body* tapering at either extremity. *Caudal sucker* pointed. *Integument* having transverse striæ; setæ or papillæ around head occasionally present. *Pharyngeal cavity* slightly dilated at first, then narrow and elongated; commencement of œsophagus marked by 4–6 bright slightly curved lines. *Œsophagus* cylindrical, but having an oval swelling posteriorly, in which is contained a horny valvular apparatus of the same shape. *Intestinal cells* mostly containing rather few pale-coloured fat-particles. *Vulva* about middle of body. *Uterus* bifid; segments short, symmetrical. *Ovarian tubes* short, broad, reflexed. *Spicules* . . . . *Excretory gland* having linear duct twisted round œsophagus, and opening nearly opposite its middle in length. *Lateral vessels* with distinct double outline, commencing at lateral circular markings of integument, opposite pharyngeal region of body, and terminating posteriorly.

Movements active.

I have little doubt that the Nematoids found by Spallanzani in tufts of moss, and ascertained by him to possess the remarkable power of resuming all the functions of life after prolonged periods of torpidity and more or less complete desiccation, belonged to this genus; and it seems probable also that Dujardin, in his observations, has confounded together such forms as the members of this, and those corresponding to the type of his genus *Rhabditis*. I have found individuals of this genus in specimens of lichen brought by my friend Howard Fox, Esq., from Norway, and which had been lying in his cabinet for four years; none of the animals, however, exhibited signs of life after prolonged immersion in water. In these specimens of lichen, as well as in the fresh patches of *Parmelia parietina* which I have examined in this country, I have found the Nematoids associated with two or three species of Rotifera, as well as the peculiarly slow-moving little animals designated "Sloths" by the Abbé Spallanzani[2], and belonging, I believe, to the genera *Emydium* and *Macrobiotus*—all possessing about the same tenacity of life.

1. P. PARIETINUS, n. sp. (Plate X. figs. 79, 80.)

Female, length $\frac{1}{23}''$, breadth $\frac{1}{400}''$.

External Characters.—Body white, tapering at either extremity, more especially posteriorly. Head truncate, provided with a circle of four large rounded papillæ. Integumental striæ transverse, $\frac{1}{18000}''$ apart.

Pharyngeal cavity $\frac{1}{643}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length. *Intestinal cells* indistinctly tessellated, containing rather few light-coloured fat-particles. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* at middle of body. *Excretory ventral gland* having twisted duct opening at $\frac{1}{133}''$ from anterior extremity. *Lateral vessels* commencing at circular markings of integument $\frac{1}{1250}''$ from anterior extremity, by narrowed portions $\frac{1}{1333}''$ in length, with delicate vessels from $\frac{1}{10000}''$ to $\frac{1}{5000}''$ broad.

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[1] Πλεκτὸς, *twisted*, in allusion to the particular character of the duct of its ventral gland.

[2] Tracts on the Nat. Hist. of Anim. and Veget., translated by Graham Dalyell, ed. 2, vol. ii. pp. 129–166.

Male, not seen.

Hab. Hemispherical tufts of moss (*Tortula*) on the roofs of old houses or walls, and also from the yellow lichen (*Parmelia parietina*), Broadmoor, Berks.

2. P. CIRRATUS, n. sp. (Plate X. figs. 81, 82.)

Female, length $\frac{1}{16}''$, breadth $\frac{1}{435}''$.

External Characters.—Body slender, tapering at both extremities, especially posteriorly. Head rounded, provided with a circle of four very short cirri, about $\frac{1}{15000}''$ long. Integumental striæ $\frac{1}{20000}''$ apart, transverse.

Pharyngeal cavity slightly dilated at first, then long and narrow, length being about $\frac{1}{666}''$. *Œsophagus* less than $\frac{1}{4}$th of total length. *Intestinal cells* not well marked, and containing but few fat-particles. *Anus* $\frac{1}{154}''$ from posterior extremity. *Vulva* slightly posterior to the middle of body. *Duct of excretory gland* opening opposite middle of œsophagus. *Lateral vessels* commencing at $\frac{1}{1250}''$ from anterior extremity.

Male, not seen.

Hab. About lower decaying leaves of *Myriophyllum verticillatum*, pond, Bagshot.

3. P. TENUIS, n. sp. (Plate X. figs. 83, 84.)

Female, length $\frac{1}{33}''$, breadth $\frac{1}{1000}''$.

External Characters.—Body white, slender, tapering very slightly anteriorly and posteriorly. Head rounded, naked. Integumental striæ transverse, almost imperceptible, $\frac{1}{30000}''$ apart.

Pharyngeal cavity $\frac{1}{750}''$ long. *Œsophagus* more than $\frac{1}{4}$th of total length. *Intestinal cells* containing but few light-coloured fat-particles. *Anus* $\frac{1}{270}''$ from posterior extremity. *Vulva* at the middle of body. *Excretory duct* opening at $\frac{1}{188}''$ from anterior extremity. *Lateral vessels* commencing at circular markings $\frac{1}{2000}''$ from anterior extremity.

Male, not seen.

Hab. In transparent gelatinous matter, with *Vorticella chlorostigma*, from the shady margin of a lake, Sandhurst.

4. P. VELOX, n. sp. (Plate X. figs. 85, 86.)

Female, length $\frac{1}{26}''$, breadth $\frac{1}{500}''$.

External Characters.—Body white, tapering anteriorly and posteriorly, especially in the latter direction. Head rounded, unarmed. Integumental striæ transverse, $\frac{1}{20000}''$ apart.

Pharyngeal cavity $\frac{1}{1000}''$ long. *Œsophagus* $\frac{1}{4}$th of total length. *Intestinal cells* indistinctly marked, containing very few light-coloured particles. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* slightly posterior to the middle of body. *Excretory duct* opening at $\frac{1}{182}''$ from anterior extremity. *Lateral vessels* commencing at $\frac{1}{1666}''$ from anterior extremity.

Male, not seen.

Hab. From moss with *T. Davaineii*, Falmouth.

5. P. ACUMINATUS, n. sp. (Plate X. figs. 87, 88.)

Female, length $\frac{1}{30}''$, breadth $\frac{1}{666}''$.

External Characters.—Body white, tapering at both extremities, especially at posterior, which is narrow and acuminated. Head rounded, unarmed. Integumental striæ transverse, $\frac{1}{20000}''$ apart.

Pharyngeal cavity narrow, elongated, $\frac{1}{1111}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length. *Intestinal cells* very indistinct, from their containing very few light-coloured fat-particles. *Anus* $\frac{1}{280}''$ from posterior extremity. *Vulva* in middle of body. *Excretory duct* opening opposite the middle portion of œsophagus. *Lateral vessels* commencing in the usual way, at $\frac{1}{2000}''$ from anterior extremity.

Male, not seen.

Hab. In moss.

6. P. PARVUS, n. sp. (Plate X. figs. 89, 90.)

Female, length $\frac{1}{47}''$, breadth $\frac{1}{1000}''$.

External Characters.—Body white, tapering anteriorly and posteriorly, especially in the latter direction. Head rounded, unarmed. Striæ transverse, $\frac{1}{30000}''$ apart.

Pharyngeal cavity $\frac{1}{1428}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length. *Intestinal cells* very indistinct. *Anus* $\frac{1}{300}''$ from posterior extremity. *Vulva* at middle of body. *Excretory duct* opening opposite middle of œsophagus. *Lateral vessels* commencing at integumental circles $\frac{1}{2000}''$ from anterior extremity.

Male, not seen.

Hab. With *P. velox*, from moss covering stone lying in a freshwater stream, Falmouth.

7. P. TRITICI, n. sp. (Plate X. figs. 91, 92.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{454}''$.

External Characters.—Body white, tapering slightly anteriorly, but more posteriorly. Head rounded, unarmed. Transverse striæ readily seen, $\frac{1}{15000}''$ apart.

Pharyngeal cavity $\frac{1}{666}''$ long. *Œsophagus* only $\frac{1}{8}$th of total length. *Intestinal cells* containing few light-coloured fat-particles. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* about the centre of body. *Excretory duct* opening at $\frac{1}{133}''$ from anterior extremity. *Lateral vessels* commencing in usual way, at $\frac{1}{1666}''$ from head.

Male, not seen.

Hab. Between the lower part of the sheaths of leaves of wheat-stalks taken from a stubble-field with sandy soil, Broadmoor, Berks.

8. P. GRANULOSUS, n. sp. (Plate X. figs. 93, 94.)

Female, length $\frac{1}{20}''$, breadth $\frac{1}{550}''$.

External Characters.—Body opaque-white, narrow at anterior extremity, but not tapering in either direction so much as usual. Head rather truncate, unarmed. Striæ transverse. Whole body much obscured by a number of rather large colourless granules.

Pharyngeal cavity $\frac{1}{1428}''$ long. *Œsophagus* $\frac{1}{5}$th of total length. *Intestinal cells* indistinct. *Anus* $\frac{1}{400}''$ from posterior extremity. *Vulva* about middle of body. *Excretory duct* opening near middle of œsophagus. *Lateral vessels* commencing at $\frac{1}{1250}''$ from anterior extremity.

Male, not seen.

Hab. About the rootlets of oats from sandy soil, Broadmoor, Berks.

9. P. FUSIFORMIS, n. sp. (Plate X. figs. 95, 96.)

Female, length $\frac{1}{27}''$, breadth $\frac{1}{526}''$.

External Characters.—Body tapering considerably, both anteriorly and posteriorly. Head truncate, leaving no papillæ, but provided with four small setæ. Integument with transverse striæ, $\frac{1}{20000}''$ apart.

Pharyngeal cavity long and narrow. *Œsophagus* $\frac{1}{4}$th of total length. *Intestinal cells* containing few light-coloured granules. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* slightly posterior to the middle of body. *Excretory duct* opening opposite commencement of posterior $\frac{1}{3}$rd of œsophagus. *Lateral vessels* commencing at $\frac{1}{1250}''$ from anterior extremity.

Male, not seen.

Hab. Tuft of bright-green moss from thatched roof, Sandhurst.

10. P. RIVALIS, Dujardin.

Enoplus rivalis, Dujardin, Hist. Nat. des Helminthes, p. 235.

"Corps blanc, filiforme, aminci en arrière, long de 2$^{\text{mm}}$·23, large de 0$^{\text{mm}}$, quarante fois aussi long que large; tête large de 0$^{\text{mm}}$·28, tronquée en avant et hérissée de quelques soies roides; bouche armée intérieurement de trois pièces étroites, arquées, qui se réunissent à l'entrée de l'œsophage; œsophage musculeux, cylindrique, long de 0$^{\text{mm}}$·34, terminé par un petit ventricule, que précède un léger étranglement.

"*Femelle* longue de 2$^{\text{mm}}$·23 à 3$^{\text{mm}}$, large de 0$^{\text{mm}}$·055 à 0$^{\text{mm}}$·08, à queue insensiblement amincie, et terminée par un petit renflement d'où part une soie courte; vulve située un peu en avant du milieu; utérus divisé en deux branches opposées, qui, arrivées à 0·$^{\text{mm}}$30 ou 0$^{\text{mm}}$·45 en avant et en arrière de la vulve, se recourbent pour se continuer avec les ovaires correspondants qui reviennent de part et d'autre jusqu'au-dessus de la vulve commes deux larges tubes contenant une pile d'œufs comprimés; œufs elliptiques, longs de 0$^{\text{mm}}$·06."

"Je l'ai trouvé dans l'eau de la Seine, à Paris, et dans l'eau courante d'une fontaine à Blagnac, près de Toulouse, ainsi que dans la Vilaine, à Rennes."

I cannot feel certain about the genus to which this animal belongs, but have placed it in that to which the nature of its œsophagus allies it most: it is evidently not an *Enoplus*.

10. APHELENCHUS[1], Bastian.

GEN. CHAR. *Body* tapering more or less at extremities; posterior pointed, or blunt and rounded. *Caudal sucker*, if present, very small. *Integument* having transverse striæ; setæ none; papillæ none (?). *Pharyngeal cavity* modified into a simple hollow exsertile (?) *spear*. *Œsophagus* having a distinct rounded muscular swelling at termination; lumen of œsophagus thread-like. *Intestine* not distinctly defined, from extremely small number and colourless nature of hepatic granules; internal or intestinal tube proper often very distinct. *Vulva* at about the commencement of posterior third of body. *Uterus* unsymmetrical. *Spicules* simple, slender, curved. *Accessory piece* none. *Excretory gland* having rather rigid, curved duct, opening posterior to junction of œsophagus with intestine. *Lateral vessels* . . . . . .

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[1] ἀφελὴς, *simple*, and ἔγχος, *a spear*.

Movements sluggish.

In a member of this genus, *Aphelenchus parietinus*, I have very frequently met with certain bodies such as I have also recognized once in a species of the genus *Plectus*, and two or three times in *Tylenchus Davainii*. In these specimens a remarkable condition has been met with, in which, beneath the integument of the whole animal, in the general cavity of its body, and, in *A. parietinus*, also within the intestinal canal, there have been a large number of small spherical cellular bodies, simply granular-looking in this last species, but in the two others presenting the appearance of small hyaline cells, each of which contains a large, highly refracting, spherical central body or nucleus. What is their precise nature seems difficult to say at present. That their occurrence is exceptional, as well as other considerations, rather inclines me to the opinion that they are distinct organisms, perhaps belonging to the family *Gregarinidæ*, "a group of animals of very simple structure, met with in the intestine and other parts of many insects and Annelids"[1]. Whatever be their nature, they seem to correspond pretty closely to what Dujardin and other helminthologists have observed in certain parasitic Nematoids. Speaking of *Ascaris truncata*, this distinguished naturalist says[2]:—"Toutes les cavités interviscérales sont occupées, chez les mâles comme chez les femelles, par des vésicules indépendentes qui ont attiré l'attention de tous les helminthologistes, mais dont on n'a point indiqué la nature. Il semble qu'on ne peut dire autre chose, sinon que ce sont des productions parasites analogues aux acéphalocystes des mammifères." And a little further on (p. 220), after describing *A. maculosa* from the Common Pigeon, speaking of Rudolphi's observations, he adds:—"Il signale aussi dans le tégument des corpuscles orbiculaires diaphanes, beaucoup plus grands que les œufs, et qui rendent le corps presque tacheté, d'où le nom spécifique de *maculosa*. En disséquant ces ascarides, on voit en effet flotter avec les œufs, dans le liquide, des vésicules larges de $0^{mm}\cdot14$ à $0^{mm}\cdot30$, sur la nature desquelles il est difficile d'être fixé. Ce sont les mêmes que l'on trouve aussi dans l'ascaride du Perroquet, et que je crois analogues à des acéphalocystes."

1. A. AVENÆ, n. sp. (Plate X. figs. 97, 98.)

Female, length $\frac{1}{20}''$, breadth $\frac{1}{454}''$.

External Characters.—Body white, tapering very slightly at either extremity, both of of which are rounded. Head having no setæ or papillæ. Caudal sucker none. Integumental striæ transverse, $\frac{1}{10000}''$ apart, easily visible.

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[1] "On our Present Knowledge of the *Gregarinidæ*," &c., by E. Ray Lankester, Journ. of Microsc. Soc., new series, vol. iii. p. 83.

[2] Hist. Nat. des Helminthes, p. 215.

Dart $\frac{1}{1666}''$ long, simple, not knobbed at the base. *Œsophagus* $\frac{1}{14}$th only of total length, having a globular and distinctly muscular terminal swelling, $\frac{1}{1000}''$ broad. *Intestine*, portion next œsophagus very indistinct; granules scattered, rather coarse and colourless. *Anus* $\frac{1}{666}''$ from posterior extremity. *Vulva* posterior to commencement of hinder third of body, $\frac{1}{77}''$ from posterior extremity. *Excretory duct* opening slightly posterior to commencement of intestine.

Male, not seen.

Hab. Between the lower sheaths of leaves of oats from stubble-field, Broadmoor, Berks.

2. A. VILLOSUS, n. sp. (Plate X. figs. 99–101.)

Female, length $\frac{1}{51}''$, breadth $\frac{1}{1000}''$.

External Characters.—Body tapering very slightly anteriorly, but narrowing to a point posteriorly; shaggy from the presence of a hair-like fungus (?) growing on integument. Sucker (?). Head rounded, naked. Striæ transverse.

Spear $\frac{1}{2500}''$ long, simple. *Œsophagus* $\frac{1}{10}$th of total length; terminal muscular swelling $\frac{1}{2000}''$ in diameter. *Intestine* sparingly covered with granules. *Anus* $\frac{1}{1000}''$ from posterior extremity. *Vulva* at commencement of posterior third of body. *Excretory duct* opening at $\frac{1}{200}''$ from anterior extremity.

Male, length $\frac{1}{66}''$, breadth $\frac{1}{1000}''$.

Anus about the same position as in female. *Spicules* $\frac{1}{1666}''$ long, narrow, curved, slightly knobbed at upper extremities.

Hab. With *Plectus parietinus*, in tufts of moss (*Tortula*), Broadmoor, Berks.

3. A. PARIETINUS, n. sp. (Plate X. figs. 102, 103.)

Female, length $\frac{1}{36}''$, breadth $\frac{1}{833}''$.

External Characters.—Body pellucid, tapering very slightly forwards, but to a point backwards, where it appears to terminate in a sucker. Head almost truncate. Transverse striæ $\frac{1}{30000}''$ apart.

Spear simple, $\frac{1}{2000}''$ long. *Œsophagus* $\frac{1}{11}$th of total length; terminal swelling $\frac{1}{2000}''$ in diameter. *Intestine* covered by a few scattered granules; internal tube well seen. *Anus* $\frac{1}{770}''$ from posterior extremity. *Vulva* at commencement of posterior third of body. *Excretory duct* opening at $\frac{1}{266}''$ from anterior extremity.

Male, not seen.

Hab. With *Plectus parietinus*, in patches of yellow lichen (*Parmelia parietina*), Broadmoor, Berks.

4. A. PYRI, n. sp. (Plate X. figs. 103 *a*–103 *c*.)

Female, length $\frac{1}{43}''$, breadth $\frac{1}{1250}''$.

External Characters.—Body naked, pellucid, filiform, tapering slightly at both extremities; sucker doubtful. Head narrowed, rounded. Integumental striæ not visible.

Spear simple, $\frac{1}{2500}''$ long. *Œsophagus* $\frac{1}{10}$th of total length; terminal swelling large, $\frac{1}{2000}''$ in diameter. *Intestine* very sparingly covered with a few light-coloured granules.

Anus $\frac{1}{588}''$ from posterior extremity. *Excretory duct* opening opposite œsophageo-intestinal junction (?). *Lateral vessels* straight, not convoluted. *Vulva* at commencement of posterior third of body.

Male, about same size as female.

Anus $\frac{1}{666}''$ from posterior extremity. *Spicules* solitary, large, curved, $\frac{1}{1250}''$ long, somewhat knobbed at upper extremities.

Hab. Found by Dr. Cobbold in the decaying pulp of pears[1].

11. CEPHALOBUS[2], Bastian.

GEN. CHAR. *Body* tapering slightly at extremities. *Head* somewhat lobed. *Caudal sucker* none. *Integument* having well-marked transverse striæ; no setæ or papillæ. *Pharyngeal cavity* indistinct. *Œsophagus* narrowed previously to its termination in a rounded swelling containing a simple valvular apparatus. *Intestine* sparingly covered with light-coloured fat-particles; intestinal tube proper easily seen. *Vulva* at commencement of posterior third of body. *Uterus* unsymmetrical. *Spicules* slightly curved, somewhat fusiform. *Accessory piece* posterior, median, easily recognizable. *Excretory ventral gland* having a somewhat rigid, curved duct, opening opposite posterior third of œsophagus. *Lateral vessels* straight; terminations uncertain.

Movements sluggish.

1. C. PERSEGNIS, n. sp. (Plate X. figs. 104–106.)

Female, length $\frac{1}{34}''$, breadth $\frac{1}{555}''$.

External Characters.—Body white, tapering slightly anteriorly, and also posteriorly, where it is blunt and rounded. Head bilobed. Striæ transverse, distinct, $\frac{1}{10000}''$ apart.

Œsophagus between $\frac{1}{4}$th and $\frac{1}{5}$th of total length. *Intestine* slightly covered with a few light-coloured hepatic particles. *Anus* $\frac{1}{625}''$ from posterior extremity. *Vulva* at posterior third of body. *Excretory duct* opposite narrowed portion of œsophagus.

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[1] In his work on "Entozoa," Dr. Cobbold, speaking of *Oxyuris vermicularis*, remarks:—"Respecting the migrations of the larvæ, I am not aware that anything very definite is yet known. I have introduced the eggs containing embryos into various animals, but have not yet succeeded in rearing young Oxyurides. I have also introduced them into the pulpy parenchyma of pears; but I have not been able to satisfy myself that any of the young Nematodes which I subsequently procured, by thousands, in one or two of the pears were the result of these experiments. I showed some of these living larvæ to Leuckart, who thought they might be *Anguillulæ*; and certainly I never saw the tadpole-like larvæ, as such, out of their shells. The young Nematodes in question displayed a very different form. As my experiments are in the act of being repeated, I will now say no more on this head" (pp. 369, 370).

I am indebted to the kindness of Dr. Cobbold for the opportunity of examining these animals, when I at once recognized two distinct species, belonging respectively to the genera *Aphelenchus* and *Plectus*. The representatives of the former genus, constituting the species above described, were by far the most numerous, though those of the genus *Plectus* were larger and much more active in their movements. The portion of pear-pulp sent to me was quite dry; but, after immersion in water for a few hours, I had no difficulty in verifying Dr. Cobbold's previous observations, and recognizing the little Nematodes in full activity, showing that they also are endowed with the same property of recovering after desiccation as are the other species of these genera. Dr. Cobbold did not recognize two distinct species; and thinking all the animals found in the pear-pulp were individuals of the same species, he proposed for it the name of *Anguillula pyri*, in a communication read before the last meeting of the British Association at Bath.

[2] *κεφαλὴ, the head,* and *λοβὸς, a lobe.*

Male, longer than female, but narrower; length $\frac{1}{31}''$, breadth $\frac{1}{625}''$.

Anus $\frac{1}{555}''$ from posterior extremity, which is altogether narrower than in the female. *Spicules* not distinctly visible, slightly curved, $\frac{1}{1000}''$ long. *Accessory piece* more distinct, straight, $\frac{1}{2000}''$ long.

Hab. Between the sheaths of leaves of wheat-stalks, from stubble-fields, Broadmoor, Berks.

2. C. STRIATUS, n. sp. (Plate X. figs. 107, 108.)

Female, length $\frac{1}{45}''$, breadth $\frac{1}{714}''$.

External Characters.—Body white, tapering anteriorly and posteriorly; posterior extremity proportionally narrower than in last species. Head bilobed. Striæ transverse, very distinct, $\frac{1}{10000}''$ apart.

Œsophagus $\frac{1}{4}$th of total length. *Intestine* sparingly covered with light-coloured hepatic particles. *Anus* $\frac{1}{500}''$ from posterior extremity. *Vulva* slightly anterior to posterior third of body. *Excretory duct* readily visible, $\frac{1}{270}''$ from anterior extremity.

Male, not seen.

Hab. Sandy soil, about rootlets of wheat, Broadmoor, Berks.

12. TYLENCHUS[1], Bastian.

Vibrio, Müller; *Anguillula*, Hemprich & Ehrenberg; *Rhabditis*, Dujardin.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker*, none. *Integument* having distinct transverse striæ; no setæ or papillæ. *Pharynx* modified into an exsertile *spear*, with a trilobed base. *Œsophagus* having a rounded muscular swelling about its middle; canal thread-like, continuous with spear, most distinct in anterior half. *Intestine* rather indistinct, sparingly covered with coarse, colourless fat-granules; intestinal tube proper easily recognizable. *Vulva* considerably posterior to middle of body. *Uterus* unsymmetrical; traces of abortive posterior median segment. *Spicules* rather stout, generally united to the posterior *accessory piece*. *Caudal alæ* in males membranous and unsupported by rays. *Duct* of excretory ventral gland linear, rigid, and curved at termination. *Lateral vessels* distinct, occasionally flexuous; terminations uncertain.

Movements sluggish.

The tenacity of life possessed by the members of this genus, as well as those of *Plectus*, *Aphelenchus*, and *Cephalobus*, is a most remarkable peculiarity, which may perhaps, in some slight degree, be accounted for by the structure of the integument, which seems calculated to enable them to resist actual desiccation and the evaporation of the natural moisture from their tissues for a much longer period than could be the case with other species, whose tegumentary organs are constructed upon a different principle. I have demonstrated by actual microscopical observation the presence of a plurality of integumental pores in the species of many genera; and all these animals (as well as many others, in which such pores have not been recognized, owing to the smallness of their size and the intrinsic difficulty of the investigation), when immersed in a dense medium, such as glycerine, almost immediately shrivel up, owing to the rapid osmosis of fluids from within; or, when placed in a colouring solution of magenta, the whole of their tissues become speedily and uniformly dyed of the same hue. But if a species of either of these four land and freshwater genera be submitted to the same conditions, they exhibit totally different results: they will continue to move about in glycerine for about fifteen or twenty minutes before commencing to shrivel, and will remain nearly as long in a strong magenta solution with the body uncoloured, save for a very short distance from the mouth and anus. Both these experiments seem to indicate that there is not such a free communication through the integument, in these species, between the internal parts of the body and the external medium, and that the integument is hermetically sealed, excepting at such natural apertures as mouth, anus, and vulva. This property may be one of the factors concerned in producing the extraordinary tenacity of life observed in these animals,—one of small significance, however, when we attempt to explain the very prolonged periods of suspended animation, extending over a series of years. This power of remaining for lengthened periods to all intents and purposes dead, inasmuch as there is a negation of all that we are apt to consider as the characteristic attributes of life, save that, like seeds, they still retain the potentiality of resuming their vital manifestations under the influence of suitable external conditions, must, doubtless, depend upon inherent peculiarities of the tissues themselves, beyond the reach of detection by optical instruments even of the highest power.

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[1] *τύλος, a knob*, and *ἔγχος, a spear.*

Another peculiarity of these four genera is the fact that they all possess the excretory gland in a modified condition, though I have not met with it at all in any of the other land and and freshwater types.

1. T. Davainii, n. sp. (Plate X. figs. 109–111.)

Female, length $\frac{1}{27}''$, breadth $\frac{1}{770}''$.

External Characters.—Body tapering at both extremities, especially towards posterior. Head narrowed, truncate. Integument thick; striæ transverse, distinct, $\frac{1}{1500}''$ apart.

Spear large, $\frac{1}{1428}''$ long. *Œsophagus* $\frac{1}{5}$th of total length; posterior part, behind median swelling, gradually widening. *Intestine* not very distinct from body generally, being obscured by large, coarse, colourless granules. *Anus* $\frac{1}{200}''$ from posterior extremity. *Vulva* considerably behind middle of body, $\frac{1}{40}''$ from anterior extremity. *Excretory duct* distinct, opening opposite posterior part of œsophagus, and extending backwards for about $\frac{1}{250}''$, where it terminates in an ovoid sac.

Male, same size as female.

Œsophagus shorter. *Anus* $\frac{1}{182}''$ from posterior extremity. *Spicules* rather narrow, $\frac{1}{714}''$ long; *accessory piece* of about half this length. *Alæ* transparent, narrow, extending, on either side, from slightly above to a little below the anus.

Hab. From sheet of moss covering large boulder lying in a freshwater stream, Falmouth.

2. T. tricici. (Plate X. figs. 112–114.)

Needham, Micr. 99, tab. v. 7.
Baker, Micr. Expl. 80, tab. v. fig. 9. 1, 2.
Roffredi, in Journal de Phys. 1775, p. 369.

Anguille vulgaire, Rozier, Obs. 1775, Mars, p. 218, tab. i. 7, et 1778, Nov. p. 401.
Anguille du blé rachitique, l. c. 1775, Janv. tab. i.
Anguille du faux ergot, l. c. 1776, Janv. p. 72, et Mars, pp. 372 et 436; Naturf. xxix. St. 40.
Spallanzani, Micr. 189. fig. 12 (pessima); idem, Opusc. Phys. ii. 354, tab. v. 10.
Eichhorn, Micr. 72, tab. vii. A.
Gleichen, Micr. 61, tab. xxviii. 6.
Spulwürmerälchen, Schrank, Beitr. 19; Würtemb. Wochenbl. 1782, p. 354.
Vibrio anguillula, γ. *Anguillula fluviatilis*, Müller, Anim. Infus. 65, tab. ix. 5–8.
V. tritici, Bauer, in Phil. Trans. 1823, i. 1–12, tab. i. et ii.—Versio in Ann. des Sc. Nat. (prem. sér.) ii. 154–167, cum tabula.—Bory, in Encycl. Méth. 1824, p. 779.—Dugès, in Ann. des Sc. Nat. (prem. sér.) ix. 225.—Henslow, in Microscopical Journal, 1841, p. 36.
Rhabditis tritici, Duj., Hist. Nat. des Helminthes, p. 242.
Anguillula graminearum, Diesing, Systema Helminthum, 1850, vol. ii. p. 132.
Anguillules de blé, Davaine, in Comptes Rendus, xli. (1855) 435–438 (de modo propagationis et immigrationis in semina frumenti).—Idem, ibid. xliii. (1856) 148, et in Institut, no. 1179 (1856) 281 (de tenacitate vitæ in individuis organis genitalibus adhuc destitutis).—Idem, Recherches sur l'Anguillule du blé niellé, Paris, 1857, avec 3 pl.

Female[1], length $\frac{1}{7}''$, breadth $\frac{1}{117}''$.

External Characters.—Body yellowish white, tapering rather abruptly forwards, but more gradually towards posterior extremity. Head rounded; no setæ or papillæ. Transverse striæ of integument not very distinct, $\frac{1}{20000}''$ apart.

Spear small, only $\frac{1}{2500}''$ long. *Œsophagus* about $\frac{1}{24}$th of total length; middle of swelling $\frac{1}{400}''$ from anterior extremity. *Intestine* much obscured by genital tubes, covered with irregularly arranged fat-particles. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* rather prominent, $\frac{1}{62}''$ from posterior extremity. *Anterior uterine segments* and *ovary* largely developed. *General cavity of body* filled with delicate parenchymatous or hyaline cells. *Excretory duct* opening at $\frac{1}{182}''$ from anterior extremity, and, in favourable specimens, visible for about $\frac{1}{80}''$ as a somewhat rigid, almost linear, curved tube. *Lateral vessels* most distinct, about $\frac{1}{3330}''$ in breadth, often much convoluted anteriorly[2].

Male, length $\frac{1}{11}''$, breadth $\frac{1}{312}''$.

Anus $\frac{1}{285}''$ from posterior extremity. *Spicules* rather broad, $\frac{1}{833}''$ long. *Accessory piece* connected with spicules, $\frac{1}{1428}''$ long. *Alæ* narrow, transparent, extending from $\frac{1}{666}''$ above anus to posterior extremity.

Hab. In gall-like growths, replacing germens in certain ears of wheat, also more rarely in those of oats and rye.

3. T. TERRICOLA, n. sp. (Plate X. figs. 115, 116.)

Female, length $\frac{1}{47}''$, breadth $\frac{1}{1250}''$.

External Characters.—Body pellucid, tapering slightly forwards, but more posteriorly. Striæ of integument transverse.

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[1] Absolute measurements of both male and female rather variable; the relative measurements, however, remain pretty constant.

[2] These are not fixed to the parietes of the body in the same way as the axial tubes or vessels of the lateral lines in certain parasitic Nematoids, but float freely in the cavity of the body. When the integument of one of these animals is ruptured by pressure of the covering-glass under the microscope, I have several times seen whole coils of the vessels slip entirely out of the cavity of the body.

Spear $\frac{1}{2500}''$ long. *Œsophagus* $\frac{1}{6}$th of total length; centre of globate swelling $\frac{1}{454}''$ from anterior extremity. *Intestine* covered with rather coarse, scattered granules. *Anus* $\frac{1}{770}''$ from posterior extremity. *Vulva* slightly posterior to anterior $\frac{2}{3}$rds of body. *Excretory duct* opening opposite commencement of posterior third of œsophagus.

Male, not seen.

Hab. From sandy soil, adhering to rootlets of wheat-plant, Broadmoor, Berks.

4. T. OBTUSUS, n. sp. (Plate X. figs. 117, 118.)

Female, length $\frac{1}{29}''$, breadth $\frac{1}{770}''$.

External Characters.—Body tapering very slightly anteriorly, and still less posteriorly, where it is blunt and rounded. Head rather truncate. Striæ transverse, $\frac{1}{20000}''$ apart.

Spear $\frac{1}{1428}''$ long. *Œsophagus* $\frac{1}{14}$th of total length, having a globate swelling about its middle. *Intestine* sparingly covered with light-coloured granules. *Anus* $\frac{1}{435}''$ from posterior extremity. *Vulva* near commencement of posterior third of body. *Excretory duct* opening slightly posterior to middle of œsophagus.

Male, length $\frac{1}{33}''$, breadth $\frac{1}{770}''$.

Anus $\frac{1}{500}''$ from posterior extremity. *Spicules* $\frac{1}{1000}''$ long. *Accessory piece* about half as long, posterior, median. *Alæ* membranous and transparent, extending on either side from a little above anus to posterior extremity.

Hab. Sandy soil, about the rootlets of oats, Broadmoor, Berks.

5. T. DIPSACI, Kühn.

Anguillula Dipsaci, J. Kühn, in Schles. Jahresber. 1857, pp. 50–53.—Idem, in Zeitsch. für Wissensch. Zool. ix. (1857) 129–137, tab. vii. C.—Diesing, Sitzungsb. der Kais. Akad. Bd. xlii. (1861) p. 628.

"*Corpus* antrorsum attenuatum transparens. *Caput* obtusum, rotundatum. *Cauda* sensim acuminata recta v. paulo incurvata. *Apertura genitalis* feminea retrorsum sita. *Ovipara.* Longit. corp. $\frac{1}{2}$–$\frac{2}{3}'''$, crassit. $\frac{1}{8}$–$\frac{1}{6}'''$; longit. caudæ maris (a pene) $\frac{1}{15}$, feminæ (a vulva) $\frac{1}{5}$ corporis longitudinis."

"***Œsophagus*** postice bulbosus."

"*Hab.* In anthodiis depravatis Dipsaci fullonum, Junio (*Kühn*)."

6. T. AGROSTIDIS.

Vibrio graminis, Steinbuch, in Naturf. xxviii. St. p. 233, tab. v., et ejus Analecten, 97, 135, tab. ii. figs. 1–6. *Anguillula graminearum* (in part), Diesing, Syst. Helminth. ii. p. 132.

It seems to me most probable that this species is distinct from *Tylenchus tritici*; the determination of this question, however, must be left to future observers.

13. RHABDITIS, Dujardin.

Anguillula, Grube.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* none. *Integument* having longitudinal as well as transverse striæ; setæ none; papillæ none. *Pharyngeal cavity* long cylindrical. *Œsophagus* distinctly muscular, having two swellings, one elongated near its middle, and the other terminal, rounded, and containing a simple valvular apparatus. *Intestine* rather sparsely covered with fat-particles, the large containing cells of which can sometimes be recognized. *Vulva* near the middle of body. *Uterus* bifid, segments symmetrical. *Oviparous* or *viviparous*. *Spicules* of moderate size, slightly curved. *Accessory piece* single, posterior, median, about half as long. *Caudal alæ* lateral, membranous, supported by sets of rays. *Ventral gland* wanting. *Lateral vessels* or *cellular canals* not seen.

Movements active.

Although I have looked very carefully for them, I have been unable to distinguish either lateral vessels or the ventral excretory gland in any of the representatives of this genus.

The typical *Rhabditis terricola* of Dujardin seems undoubtedly to correspond as regards structural details with the other species that I have placed in this genus; and, since it is now evident that Dujardin associated with this animal others of such diverse types as *Anguillula aceti* and *Tylelenchus tritici*, we shall have the less difficulty in imagining that he may have confounded with them also members of the genus *Plectus*, not only because they seem to be much more abundant than are the proper representatives of the genus *Rhabditis*, but also because he speaks of the latter as possessing that remarkable tenacity of life which belongs to species of the two former genera, when, as far as my experience goes, it is not possessed by the real allies of the typical *Rhabditis terricola*.

1. R. MARINA, n. sp. (Plate X. figs. 60–62.)

Female, length $\frac{1}{9}''$, breadth $\frac{1}{161}''$.

External Characters.—Body tapering considerably anteriorly, but more posteriorly, where it narrows to a point. Head truncate, naked. Integument having transverse and longitudinal striæ, those of each set being about $\frac{1}{10000}''$ apart.

Pharyngeal cavity cylindrical, $\frac{1}{1111}''$ long. *Œsophagus* $\frac{1}{9}$th of total length, containing in its terminal enlargement a valvular apparatus, which may be seen to open and shut with spring-like rapidity for the passage of fluids. Posterior part of œsophagus and anterior portion of intestine fixed to parietes by distinct muscular retinacula. *Intestine* much larger at commencement than terminal part of œsophagus; covered sparsely with fat-particles, the containing cells of which can occasionally be recognized. *Anus* $\frac{1}{166}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Uterus* bifid; segments symmetrical, large, and densely distended with freely moving young and ova in all stages of development. *Ova* $\frac{1}{400}''$ long, by $\frac{1}{666}''$ broad. *Gland-system* very slightly developed; but numerous floating gland- or blood-cells in cavity of body, the maximum size being about $\frac{1}{1666}''$ in diameter[1].

Male, length $\frac{1}{12}''$, breadth $\frac{1}{200}''$.

Anus $\frac{1}{285}''$ from posterior extremity. *Genital tube* consisting of a single testicle,

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[1] I have observed (in the female only) what appear to be two lateral apertures through the integument, connected with an obscure appearance of oval vesicles or dilatations internally, situated exactly midway between the anus and posterior extremity.

divided by a narrow constricted portion from the broad vas deferens. *Spicules* and *accessory piece* united together; segments of former $\frac{1}{454}''$ long. *Spermatozoa* cylindrical, $\frac{1}{5000}''$ long, having slow oscillating movement. *Alæ* two, composed of a hyaline membrane extending on each side from $\frac{1}{285}''$ above anus to posterior extremity, supported by nine rays in sets of one, two, and three.

Hab. Marine, in sand from tide-pools, Falmouth.

2. R. LONGICAUDATA, n. sp. (Plate X. figs. 63, 64.)

Female, length $\frac{1}{14}''$, breadth $\frac{1}{222}''$.

External Characters.—Body white, tapering gradually anteriorly, but more abruptly towards the posterior extremity, which is long and filiform. Head truncate, naked. Integument with longitudinal striæ, $\frac{1}{10000}''$ apart; transverse not recognized.

Pharyngeal cavity cylindrical, $\frac{1}{1000}''$ long by $\frac{1}{5000}''$ broad. *Œsophagus* $\frac{1}{7}$th of total length. *Intestine* very broad at commencement, before it is compressed by genital organs; covered by only a very few scattered fat-particles. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* very slightly anterior to middle of body.

Male, not seen.

Hab. Sandy soil about roots of wheat, Broadmoor, Berks.

3. R. ORNATA, n. sp. (Plate X. figs. 65–67.)

Female, length $\frac{1}{22}''$, breadth $\frac{1}{500}''$.

External Characters.—Body white, tapering anteriorly, but more posteriorly, where it is filiform. Head truncate, naked. Integument very transparent, with transverse striæ $\frac{1}{20000}''$ apart; longitudinal not recognized.

Pharyngeal cavity $\frac{1}{1111}''$ long. *Œsophagus* about $\frac{1}{6}$th of total length. *Intestine*, just at commencement, devoid of hepatic granules; remaining portion sparingly covered with large and rather dark-coloured particles. *Anus* $\frac{1}{200}''$ from posterior extremity. *Vulva* exactly in centre of body.

Male, length $\frac{1}{23}''$, breadth $\frac{1}{555}''$.

Anus $\frac{1}{400}''$ from posterior extremity. *Spicules* not very broad, slightly curved, $\frac{1}{588}''$ long, and connected with a posterior median accessory portion of one-half the length. *Alæ* lateral, same as in *R. marina.*

Hab. Between sheaths of leaves, stalks of wheat in stubble-fields, Broadmoor, Berks.

4. R. ACRIS, n. sp. (Plate X. figs. 68–70.)

Female, length $\frac{1}{35}''$, breadth $\frac{1}{666}''$.

External Characters.—Body white, tapering forwards and also towards posterior extremity, which terminates in a sharp point. Head truncate. Integument with transverse striæ, $\frac{1}{20000}''$ apart; longitudinal not seen.

Pharyngeal cavity $\frac{1}{2000}''$ long. *Œsophagus* about $\frac{1}{5}$th of total length. *Intestine* covered with few but large and dark-coloured hepatic granules. *Anus* $\frac{1}{294}''$ from posterior extremity. *Vulva* slightly posterior to middle of body.

Male, length $\frac{1}{41}''$, breadth $\frac{1}{909}''$.

Anus $\frac{1}{714}''$ from posterior extremity. *Spicules* double, $\frac{1}{1250}''$ long, united to a post-median *accessory piece* of one-half the length. *Alæ* on each side of tail, supported by nine minute rays, same as in other species[1].

Hab. Sandy soil about the rootlets of wheat, Broadmoor, Berks.

5. R. TERRICOLA, Dujardin.

Angiostomum terricola, Diesing, in Syst. Helminth. ii, p. 139.

"Corps blanc, fusiforme, allongé, quinze fois environ aussi long que large; tête large de $0^{\mathrm{mm}}\cdot016$; bouche suivie d'un pharynx prismatique, long de $0^{\mathrm{mm}}\cdot03$; œsophage long de $0^{\mathrm{mm}}\cdot13$ à $0^{\mathrm{mm}}\cdot2$, *renflé en fuseau,* large de $0^{\mathrm{mm}}\cdot033$ au milieu, élargi de nouveau en arrière pour se continuer avec le ventricule beaucoup plus large (de $0^{\mathrm{mm}}\cdot04$ à $0^{\mathrm{mm}}\cdot045$).

"*Mâle* long de $0^{\mathrm{mm}}\cdot50$ à $1^{\mathrm{mm}}\cdot05$, large de $0^{\mathrm{mm}}\cdot025$ à $0^{\mathrm{mm}}\cdot07$; queue courte, un peu courbée, terminée en pointe fine, et munie en dessous de deux ailes latérales, soutenues par sept à huit côtes chacune; anus à $0^{\mathrm{mm}}\cdot04$ de l'extrémité; deux spicules, longs de $0^{\mathrm{mm}}\cdot06$.

"*Femelle* longue de $0^{\mathrm{mm}}\cdot5$ à 2^{mm}, large de $0^{\mathrm{mm}}\cdot025$ à $0^{\mathrm{mm}}\cdot10$; queue droite, amincie et prolongé en pointe fine plus ou moins longue; anus à $0^{\mathrm{mm}}\cdot14$, au moins, de l'extrémité; vulve située vers le milieu; utérus très-large, musculeux au-dessus de la vulve, puis divisé en deux branches opposées; œufs elliptiques, longs de $0^{\mathrm{mm}}\cdot05$ à $0^{\mathrm{mm}}\cdot06$, contenant un embryon replié trois fois.

"Cet helminthe, si remarquable par sa structure, ne l'est pas moins par son habitation dans la terre humide et parmi les mousses, où il peut subir une dessication complète sans périr, et d'où il est entraîné par la pluie dans les fossés et les rivières. Il passe ensuite comme nourriture dans l'intestin des limaces, et de là dans l'intestin de la grenouille rousse, qui dévore ces mollusques; ou bien il est avalé dans les eaux par les gastérostés et divers petits poissons. On le trouve enfin aussi dans les lombrics; mais là il paraît avoir pris naissance dans des masses de parenchyme, libres entre l'intestin et l'enveloppe musculeuse. Je l'ai vu plusieurs fois, soit à Paris, soit à Rennes, se développer en quantité prodigieuse et former des amas blanchâtres dans des vases où j'avais conservé des lombrics avec de la mousse et de la terre humide[2]. Je l'ai trouvé communément dans les plaques d'oscillaires qui se développent sur la terre humide et dans les touffes de mousses (*Bryum*) qui se trouvent sur le sol et même sur les murs."

"Les exemplaires que j'ai recueillis dans l'intestin des *Gasterosteus* sont longs de $1^{\mathrm{mm}}\cdot55$; leur queue est plus brusquement amincie ou subulée, longue de $0^{\mathrm{mm}}\cdot07$; les œufs sont longs de $0^{\mathrm{mm}}\cdot062$."

"J'ai trouvé fréquemment, soit dans la terre humide ou dans les eaux vaseuses, ou dans l'intestin des batraciens et des mollusques, divers *Rhabdites* qui diffèrent du précédent par leur œsophage cylindrique et non renflé en fuseau. Ce sont, 1°, des vers filiformes, longs de $0^{\mathrm{mm}}\cdot25$, larges de $0^{\mathrm{mm}}\cdot016$, dans les oscillaires à Paris; 2° des vers fusiformes, longs de $0^{\mathrm{mm}}\cdot5$, larges de $0^{\mathrm{mm}}\cdot026$, parmi les conferves, sur les murs humides des fontaines à Toulon; 3° des vers longs de $0^{\mathrm{mm}}\cdot6$, larges de $0^{\mathrm{mm}}\cdot3$, à queue obtuse, et ayant l'œsophage étroit, long de $0^{\mathrm{mm}}\cdot15$, parmi les oscillaires; 4° un ver long de $0^{\mathrm{mm}}\cdot53$, large de $0^{\mathrm{mm}}\cdot02$, ayant les baguettes du pharynx longues de $0^{\mathrm{mm}}\cdot023$, et l'œsophage long de $0^{\mathrm{mm}}\cdot08$, dans l'intestin du *Triton variegatus*, etc."

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[1] In the only male of this species observed by myself, there was a swelling or development of the integument around the head for a distance of $\frac{1}{1428}''$, somewhat similar to what is met with in *Oxyuris vermicularis.* Whether this will prove to be a constant character I cannot say.

[2] *Vide* note, p. 77.

I have thought it best to give Dujardin's description and remarks concerning this species entire. From the great difference between the measurements given of this *Rhabditis terricola*, I think it very probable that Dujardin may not clearly have distinguished between two or more different species of this genus; whilst the animals referred to in his subsequent remarks, I have little doubt, belong to several totally distinct genera.

6. R. MUCRONATA.

Anguillula mucronata, Grube, in Wiegmann's Archiv, 1849, i. 361–365, tab. vii. 11–14 (cum anatom.).—Diesing, Syst. Helminth. ii. p. 557.

"*Extremitate* corporis antica lentius attenuata, truncata, bifariam e longitudine crenata, postica vix attenuata, fœmina rotundata, mucronata, maris in paleam maxime excavatam (costulis sustentam) desinente; œsophago postice bulboso, vulva in medio corpore sita. *Vivipara*. Longit. vix $\frac{1}{2}'''$; crassit. vix $\frac{1}{24}'''$."

"*Hab.* In terra humida cum lumbricis servata (*Grube*)."

MARINE.

14. SYMPLOCOSTOMA[1], Bastian.

Enoplus, Eberth; *Urolabes*, Carter.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* well developed. *Integument* plain, or with longitudinal markings; setæ none (?). *Pharyngeal cavity* elongated, somewhat fiddle-shaped, having a peculiar funnel-shaped body lying along its inferior aspect, and an appearance of three or more circular lines around the parietes. *Œsophagus* gradually widening posteriorly, not distinctly muscular, embraced in some part of middle third by *glandular ring*. *Intestinal cells* large, well filled with dark-coloured granules; often very irregularly disposed in adult specimens. *Vulva* about middle of body. *Uterus* bifid; segments symmetrical. *Spicules* long, narrow. *Accessory piece* wanting. *Ocelli* present or absent. *Glandular system* well developed, especially at anterior and posterior extremities. *Excretory ventral gland* opening near anterior extremity; duct containing a granular fluid, and much contracted just before termination. *Lateral canals* . . . . . .
Movements active.

I have temporarily placed in this genus three species, which will, in all probability, have to be removed hereafter: the first is *S. vivipara*, about the exact structure of whose pharynx I have not had sufficient opportunity of satisfying myself; and the other two, evidently very closely allied, are *Enoplus ornatus* of Eberth and *Urolabes barbata* of Carter. These would appear not exactly to belong to this genus, but to a type very similar. Future observation must decide this point.

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[1] *σύμπλοκος, complex,* and *στόμα, a mouth.*

1. **S. LONGICOLLIS**, n. sp. (Plate XI. figs. 119–122.)

Female, length $\frac{1}{8}''$, breadth $\frac{1}{250}''$.

External Characters.—Body smooth; anterior extremity tapering much, long, and narrow; posterior tapering more quickly. Caudal sucker well developed. Head truncate, naked. Integument with an appearance of longitudinal markings, $\frac{1}{6000}''$ apart.

Pharyngeal cavity somewhat fiddle-shaped, length $\frac{1}{1428}''$, having funnel and three circular markings. Two circular, highly refracting, colourless bodies (on œsophagus?) near termination of pharyngeal cavity. *Œsophagus* $\frac{1}{5}$th of total length. *Intestinal cells* large, from $\frac{1}{1000}''$ to $\frac{1}{500}''$ in diameter, containing an abundance of dark fawn-coloured granules, sometimes varying in shade in contiguous cells, and these themselves often very irregularly disposed. *Anus* $\frac{1}{118}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Ocelli* none. *Glandular system* around middle third of œsophagus highly developed, and also at posterior extremity behind anus. *Excretory ventral duct* opening at $\frac{1}{300}''$ from anterior extremity.

Male, slightly larger than female.

Anus $\frac{1}{100}''$ from posterior extremity. *Spicules* long and narrow, very slightly curved, length $\frac{1}{172}''$.

Hab. From tide-pools, on *Cladophora rupestris* and other fine green and brown weeds on which Diatomaceæ abound, Falmouth and Brighton.

2. **S. TENUICOLLIS.**

Enoplus tenuicollis, Eberth, Untersuch. über Nematoden, 1863, p. 41, tab. iv. fig. 16, tab. v. figs. 1 & 2.

"*Körper* fast gerade, cylindrisch, gegen beide Enden ziemlich gleich stark verschmälert. Hinterende bei dem Weibchen gerade, bei dem Männchen eingerollt. Kopf quer abgestutzt. Schwanz mit einer grösseren Papille versehen."

"Länge des Weibchens 6 Mm., Breite 0·15 Mm.

"Länge des Männchens 4·5 Mm., Breite 0·09 Mm.

"Oesophaguslänge$=\frac{1}{5}$ der Körperlänge"[1].

3. **S. VIVIPARA**, n. sp. (Plate XI. figs. 123–125.)

Female, length $\frac{1}{12}''$, breadth $\frac{1}{294}''$.

External Characters.—Body tapering considerably at extremities, especially at posterior, which is long, filiform, and terminates with a minute sucker. Head slender, rounded, provided with a circlet of 6–8 spreading setæ. Integument with longitudinal markings about $\frac{1}{10000}''$ apart.

Pharyngeal cavity of a somewhat elongated-oval shape, containing no funnel or circular markings (?), $\frac{1}{1666}''$ in length. *Œsophagus* about $\frac{1}{6}$th of total length, gradually widening posteriorly, and embraced by a *glandular ring* at about its middle. *Intestine* irregularly and rather sparsely covered with somewhat large fat-particles. *Anus* $\frac{1}{117}''$ from posterior extremity. *Vulva* in centre of body. *Uterus* bifid. *Segments* symmetrical. *Viviparous*. *Excretory ventral gland* . . . . . ?

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[1] Unless specified to the contrary, Eberth's species have been found at Nizza, amongst Algæ and Sertulariæ. In the description of this, as well as other species discovered by him, I have merely given the *external characters*. In his memoir, in addition to beautiful coloured drawings of each species, will be found lengthy descriptions, including many interesting and accurate anatomical details. It should be consulted by all interested in this subject.

Male, length $\frac{1}{17}''$, breadth $\frac{1}{370}''$.

Anus $\frac{1}{154}''$ from posterior extremity. *Spicules* $\frac{1}{400}''$ long, solitary, very slender, and slightly curved.

Hab. Fine surface-mud from marine estuary, Falmouth.

4. S. ORNATA.

Enoplus ornatus, Eberth, Untersuch. über Nematod. 1863, p. 40, tab. iv. figs. 13–15, tab. v. figs. 5 & 6.

"*Körper* fadenförmig, gegen beide Enden verschmälert. Vorderleib gerade, Hinterleib bei beiden Geschlechtern eingerollt, stärker bei dem Männchen als bei dem Weibchen. Kopf fast quer abgestutzt. Schwanz stumpfspitz mit feiner terminalen Oeffnung. Hinter dem Munde ist der Körper leicht eingeschnürt.

"Länge des Weibchens 4 Mm., Breite 0·125 Mm.

"Länge des Männchens 5 Mm., Breite 0·1 Mm.

"Verhältniss der Oesophaguslänge zur Körperlänge wie 1 : 4."

5. S. BARBATA.

Urolabes barbata, Carter, Ann. of Nat. Hist. ser. 3, vol. iv. (1859) p. 43, pl. iii. fig. 32.

"*Female.* Body the same as the last (*U. ocellata*), but much longer. Head furnished with four linear, short cirri. Tail short, somewhat curved, furnished with a short, pointed, digital termination. Mouth and anus the same. Vulva situated much posteriorly to the middle of the body, about the junction of the middle with the anterior third of the posterior half."

"Alimentary canal the same as in the foregoing species, but the intestinal sheath terminating less abruptly upon the commencement of the rectum. Hepatic organ the same. Organs of generation double, occupying the middle part of the body; their form undetermined. *Ocelli* at some distance from the head, of the same colour as in *U. infrequens*."

"*Size* $\frac{1}{7}$th inch long, and $\frac{1}{600}$th of an inch broad."

"*Male*, the same as the female; but with a large, thick, curved tail, obtuse at the extremity, tuberculated in its inner curvature, and furnished on each side with a row of short setæ, extending from above the anus towards the tip; also three or four setæ on the outer curvature. Testes and penis the same as in the foregoing species; form of the testes undetermined."

Hab. "Silty clots of Oscillatoria floating in the salt-water main drain of the town of Bombay."

15. ONCHOLAIMUS, Dujardin.

***Enoplus*, Diesing & M. Schultze.**

GEN. CHAR. *Body* often elongated; posterior extremity blunt- or sharp-pointed. *Caudal sucker* variable, sometimes well developed, with 2 or 3 distinct sucker-tubes. *Integument* plain or with longitudinal markings; cephalic setæ generally present, and occasionally a few scattered over other parts of the body; cephalic papillæ wanting; integumental pores most distinct in mid-dorsal and ventral regions. *Pharyngeal cavity* large, ovoid, bounded by horny parietes, and having three longitudinal, slightly curved, tooth-like projections from its inner surface. *Œsophagus* not distinctly muscular, cylindrical, and almost uniform in size; surrounded by a distinct *œsophageal ring*. *Intestine* mostly covered with olive-coloured particles, having a tessellated arrangement. *Vulva* at centre of body, or occasionally at posterior third. *Uterus* symmetrical or unsymmetrical. *Spicules* two, with or without a single *accessory piece*. *Ocelli* mostly wanting. *Excretory ventral gland* simple, tubular, extending from the anterior third nearly to the termination of œsophagus. *Lateral canals* often distinctly cellular.

Movements active.

This is not quite so natural an assemblage as those presented by some of the other genera, even after the freshwater species formerly included by Dujardin have been transferred to the genus *Mononchus*. In some members of this genus *Oncholaimus* the vulva is posterior, and the uterus unsymmetrical; and in some males also the spicules are solitary, whilst in one at least, *O. vulgaris*, there is a large and well-developed accessory piece. Owing to my not having found in several cases both the male and female representatives of the same species, I am unable to say, from my own observation, whether these alterations in the male and female organs are generally coincident, and constant enough to enable the species to be ranged under two distinct subgenera; and, unfortunately, the details concerning the anatomy of those discovered by other observers are too scanty to afford any assistance in the solution of this question. In two species also, *O. fuscus* and *O. albidus*, I have been unable to detect the usual œsophageal ring.

1. O. VULGARIS, n. sp. (Plate XI. figs. 126–128 *a*.)

Female, length $\frac{1}{2}''$, breadth $\frac{1}{143}''$.

External Characters.—Body elongated, cylindrical, tapering very slightly at extremities. Sucker well developed, with three large sucker-tubes occupying nearly the whole of the cavity of body posterior to anus. Head truncate, with a circlet of 4–6 short, stout setæ, and a few smaller ones scattered over anterior part of body. Integument thick, with an appearance of longitudinal markings $\frac{1}{5000}''$ apart; integumental pores distinct in mid-dorsal and ventral regions.

Pharyngeal cavity $\frac{1}{285}''$ long by $\frac{1}{666}''$ broad, having three strongly marked, slightly curved teeth projecting into cavity. *Œsophagus* about $\frac{1}{9}$th of total length, nearly uniform in size, having three longitudinal rows of pigment-granules; embraced at termination of anterior third by an *œsophageal ring*. *Intestine* broad, having a thick coating of olive-coloured hepatic granules, enclosed in cells, and presenting a distinct tessellated arrangement. *Anus* $\frac{1}{154}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Uterus* bifid. *Excretory ventral gland* opening close to the œsophageal ring. *Lateral canals* distinct, cellular.

Male, length $\frac{4}{10}''$, breadth $\frac{1}{91}''$.

Anus $\frac{1}{250}''$ from posterior extremity. *Spicules* rather wider at middle, and tapering towards extremities, $\frac{1}{190}''$ long. *Accessory piece* single, somewhat triangular, $\frac{1}{454}''$ long by $\frac{1}{666}''$ broad at the base. A large mid-ventral prominent *sucker* $\frac{1}{154}''$ above anal cleft.

Hab. Amongst half-tide sand and stony débris very abundant, and also found once on a bright grass-green filiform weed (free from Diatomaceæ) from tide-pool, Falmouth.

2. O. GLABER, n. sp. (Plate XI. figs. 129, 130.)

Female, length $\frac{1}{25}''$, breadth $\frac{1}{833}''$.

External Characters.—Body tapering slightly forwards, but considerably towards posterior extremity, which is long, narrow, and pointed, and terminates with a minute sucker. Head rounded, naked. Integument plain or with longitudinal markings.

Pharyngeal cavity $\frac{1}{1666}''$ long. *Œsophagus* about $\frac{1}{4}$th of total length, embraced obliquely, near its middle, by an *œsophageal ring. Intestine* thinly covered with hepatic particles. *Anus* $\frac{1}{160}''$ from posterior extremity. *Vulva* about middle of body. *Excretory ventral duct* . . . . . .

Male, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

3. O. VISCOSUS, n. sp. (Plate XI. figs. 131–133.)

Female, length $\frac{1}{13}''$, breadth $\frac{1}{714}''$.

External Characters.—Body long and filiform, scarcely at all narrowed anteriorly, but tapering gradually to a point at posterior extremity, which terminates with a minute sucker. Head bluntly rounded, provided with a circlet of four setæ. Integument plain or with longitudinal markings, having numerous fine particles of sand and diatoms adhering to its external surface.

Pharyngeal cavity $\frac{1}{1111}''$ long. *Œsophagus* $\frac{1}{7}$th of total length, embraced obliquely, near its middle, by an *œsophageal ring. Intestine* sparsely covered with hepatic particles. *Anus* $\frac{1}{222}''$ from posterior extremity. *Vulva* at middle of body. *Uterus* bifid.

Male, the same length as female, breadth $\frac{1}{833}''$.

Anus $\frac{1}{285}''$ from posterior extremity. *Spicules* solitary, of an elongated wedge-shaped form, and $\frac{1}{1000}''$ long.

Hab. Marine surface-mud from estuary, Falmouth.

When a thin layer of mud is spread out with water on a slip of glass, I have met with this species generally floating on the surface, appearing under a hand-lens as a slowly moving pellucid filament.

4. O. FUSCUS, n. sp. (Plate XI. figs. 139, 140.)

Male, length $\frac{1}{7}''$, breadth $\frac{1}{166}''$.

External Characters.—Body stout, of a brownish colour, tapering slightly forwards, but abruptly posterior to anus. Terminal sucker minute. Head narrow, rounded, having a circlet of 6–8 short, thick setæ at $\frac{1}{1250}''$ from anterior extremity. Integument having longitudinal markings; slightly tinged of a blackish colour at posterior extremity.

Pharyngeal cavity $\frac{1}{450}''$ long, large, elongated-oval; one tooth much larger than either of the other two. *Œsophagus* about $\frac{1}{6}$th of total length; slightly enlarged posteriorly; no *ring* visible. *Intestine* thickly covered with dark-brown hepatic particles; tessellation indistinct. *Anus* $\frac{1}{154}''$ from posterior extremity. *Spicules* long and narrow, very dark in colour, hollow, $\frac{1}{143}''$ long; *accessory piece* wanting. *Excretory ventral gland* not recognized.

Female, not seen.

Hab. Marine surface-mud of estuary, Falmouth.

5. O. ALBIDUS, n. sp. (Plate XI. figs. 141, 142.)

Female, length $\frac{1}{4}''$, breadth $\frac{1}{166}''$.

External Characters.—Body elongated, whitish in colour, tapering anteriorly, but more towards posterior extremity; terminating in a moderate-sized sucker. Head truncate, provided with a circlet of four short, stout setæ, and a few smaller ones scattered over anterior part of body. Integument having longitudinal markings.

Pharyngeal cavity broadly ovate, $\frac{1}{588}''$ long. *Œsophagus* short, about $\frac{1}{10}$th of total length; enlarging slightly posteriorly; no *ring* seen. *Intestine* moderately well covered with rather light-coloured hepatic particles tessellated in arrangement. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* considerably behind middle of body, $\frac{1}{15}''$ from posterior extremity. *Uterus* unsymmetrical. *Ova* very large, in single file, occupying the whole width of the body, and somewhat flattened against its parietes. *Excretory ventral gland* opening far forward, at $\frac{1}{285}''$ from anterior extremity.

Male, not seen.

Hab. Amongst small stones and sand in tide-pools, Falmouth.

6. O. VIRIDIS, n. sp. (Plate XI. figs. 137, 138.)

Female, length $\frac{1}{9}''$, breadth $\frac{1}{333}''$.

External Characters.—Body of a light-greenish hue, tapering very slightly forwards, but somewhat abruptly behind anus, where it terminates with a pretty distinct sucker and sucker-tubes. Head truncated, provided with a circlet of 4–6 setæ; a few other smaller ones scattered over anterior part of body. Integument having longitudinal markings.

Pharyngeal cavity broad anteriorly, $\frac{1}{833}''$ long. *Œsophagus* about $\frac{1}{6}$th of total length, uniform in size, embraced obliquely by *ring* near its middle; having a collection of pigment immediately behind pharynx somewhat resembling an *ocellus*. *Intestine* well covered with hepatic particles having a distinctly tessellated arrangement. *Anus* $\frac{1}{285}''$ from posterior extremity. *Vulva* prominent, considerably behind middle of body, $\frac{1}{31}''$ from posterior extremity. *Uterus* unsymmetrical.

Male, not seen.

Hab. Small filamentous green weed from tide-pool, Falmouth.

7. O. ATTENUATUS, Dujardin. (Plate XI. figs. 134–136.)

Enoplus attenuatus, Diesing, Syst. Helminth. ii. p. 125.

Female, length $\frac{1}{10}''$, breadth $\frac{1}{435}''$.

External Characters.—Body long and slender, tapering very slightly at extremities, though most at posterior, which is somewhat blunt, and terminated by a well-marked sucker, with which are connected sucker-tubes. Head bluntly rounded, provided with a circlet of 6–8 setæ. Integument having longitudinal markings.

Pharyngeal cavity elongated, $\frac{1}{666}''$ in length. *Œsophagus* about $\frac{1}{8}$th of total length, uniform in size, embraced by a *ring* near its middle, having three longitudinal lines of pigment more or less distinct, and two distinct local aggregations immediately behind pharynx (*pseudocelli*), varying in colour from brown to carmine. *Intestine* covered with hepatic particles having a tessellated arrangement. *Anus* $\frac{1}{285}''$ from posterior extremity; posterior boundary of anal cleft rather prominent. *Vulva* prominent, some distance behind middle of body. *Uterus* unsymmetrical. *Floating gland-cells* numerous, large, about $\frac{1}{3000}''$ in diameter. *Excretory ventral duct* opening far forwards, only $\frac{1}{400}''$ from anterior extremity, by a very narrow portion immediately following a small pyriform dilatation. *Lateral canals* of a green colour and granular, with the appearance of an axial channel.

Male, length $\frac{1}{11}''$, breadth $\frac{1}{500}''$.

Posterior extremity curved, shorter, more abruptly narrowed, and having two median setæ immediately above anal cleft. *Œsophagus* about $\frac{1}{5}$th of total length. *Anus* $\frac{1}{590}''$ from posterior extremity. *Spicules* almost straight, slender, $\frac{1}{833}''$ long; *accessory piece* wanting.

Hab. Found, with *Chromadora vulgaris*, *C. filiformis*, and *Cyatholaimus ocellatus*, on a stunted and dingy specimen of *Cladophora rupestris* from half-tide pool, Falmouth.

The specimens found by myself seem to agree so closely with the short description Dujardin has left us of his *Oncholaimus attenuatus*, as to make me think they must belong to the same species. The principal difference is that he mentions a "série de soies roides" above the anus in the male, whilst I have only recognized a single pair in this situation. His description is as follows:—"Corps filiforme, très-mince, cinquante fois aussi long que large; tête munie latéralement de deux ou quatre *soies courtes*; cavité buccale alongée, armée de trois pièces longitudinales, étroites, portant chacune une forte dent au milieu; *deux taches rouges* contiguées près du pharynx; œsophage long de 0$^{\text{mm}}$·4, large de 0$^{\text{mm}}$·025."

"*Mâle*, long de 2$^{\text{mm}}$·4, large de 0$^{\text{mm}}$·045; queue brusquement rétrécie en arrière de l'anus, recourbée en crochet et terminée par une sorte de papille (ou ventouse?); anus à 0$^{\text{mm}}$·033 de l'extrémité, accompagné d'une double *série de soies roides*; spicules longs de 0$^{\text{mm}}$·03."

"Dans l'eau de mer, entre les algues, à Lorient." (Hist. Nat. des Helminth. p. 236.)

8. O. PAPILLOSUS, Eberth.

Untersuch. über Nemat. p. 26, tab. i. figs. 13–17.

"*Körper* gestrickt, das Vorderende wenig verschmälert, quer abgestutzt. Das Hinterende des Weibchens gerade, in eine lange Spitze ausgezogen. Bei dem Männchen macht das Hintertheil eine leichte Krümmung gegen den Rücken, biegt sich aber dann mit der äussersten Spitze wieder gegen den Bauch.

"Länge des Weibchens 3 Mm., Breite 0·075.

"Oesophagus=ein Viertel der Körperlänge."

9. O. MEGASTOMA, Eberth.

Untersuch. über Nemat. p. 26, tab. i. figs. 18–20.

"*Körper* fast gerade, fadenförmig, gegen den Vorderleib wenig verschmälert Mund-ende abgerundet, Schwanzende beim Männchen stark verdünnt, weniger bei dem Weibchen, leicht eingebogen."

"Weibchen 3 Mm. lang, 1 Mm. breit.

"Männchen 5–6 Mm. lang.

"Oesophagus = ein Sechstel der Körperlänge."

I have retained this species provisionally in the genus *Oncholaimus*, where it was placed by Eberth, though the representation he has given of this animal seems to indicate that it possesses a form of pharynx different, not only from that characteristic of the genus *Oncholaimus*, but also from that possessed by any other type that I have yet examined.

10. O. ECHINI, Leydig.

Müller's Archiv, 1854, p. 291.—Diesing, Sitzungsb. der Kais. Akad. Bd. xlii. (1861) p. 626.—Eberth, Untersuch. über Nemat. p. 25.

"*Corpus* utrinque attenuatum. *Os* dentibus pluribus instructum. *Ovipara*. Longit. 4‴."

"*Hab. Echinus esculentus*, in intestinis (*Leydig*)."

Probably swallowed accidentally; and it seems doubtful whether it really belongs to this genus.

11. O. RIVALIS, Leydig.

Müller's Archiv, 1854, p. 291, tab. xi. 89.—Diesing, Sitzungsb. der Kais. Akad. Bd. xlii. (1861) p. 626. —Eberth, Untersuch. über Nemat. p. 25.

"*Os* dentibus duobus lateralibus et tertio intermedio denticulato instructum. *Vivipara*. Longit. . . . . . ."

"*Hab.* Sub saxis Meni frequenter (*Leydig*)."

If this really belongs to the genus *Oncholaimus*, it is the only freshwater species yet discovered.

16. ENCHELIDIUM, Ehrenberg.

"*Body* often 3–6 mm. long, straight or slightly curved. Head blunt, rounded off or truncate. Posterior extremity pointed, provided with a perforated sucker. Mouth plain, or with four small punctiform papillæ.

"*Skin* consisting of two or three layers, having, especially on fore part of body, several hairs implanted in its substance; larger cirrhi around the mouth. Behind the pharynx there opens on the ventral surface either a small gland or a tube reaching to commencement of intestine.

"An agglomeration of small cells in the place of tail-glands.

"Lateral lines simple, narrow, cellular cords.

"*Organs of Digestion.*—No pharynx. Œsophagus cylindrical, widening posteriorly; the external sheath finely granular, or transversely striped. Anus at the base of tail.

"*Organs of Generation.*—Two spicules, or a larger and a smaller pair, the latter being rather posterior.

" Bright ring around the œsophagus, which in one case appeared to be incomplete.

" *Ocelli.*—One large, ring-formed mass surrounding œsophagus, and having several lenses anteriorly."—*Eberth, Unters. über Nemat.* p. 23.

1. E. MARINUM, Ehrenberg.

Enchelidium marinum, Ehrenberg, Die Akaleph. d. roth. Meer, u. d. Organism. d. Medus. 1836, pp. 41, 57.—Dujardin, Hist. Nat. des Helm. p. 238.—Diesing, Syst. Helminth. ii. p. 127 (partim).—Oersted, De regione marinis, 1844, p. 69.

" *Corpus* capillare, extremitate caudali subulata. *Caput* corpore continuum, truncatum. *Os* terminale, orbiculare, cirrhatum? *Ocellus* pone os. *Penis* . . . .; feminæ apertura genitalis . . . . Longit. . . . .

" *Hab.* Inter mucosa palos marinos obvestientia, et in aqua marina servata frequentissime."

2. E. TENUICOLLE, Eberth.

Unters. über Nemat. p. 23, tab. iii. figs. 1–3.

" *Körper* des Männchens fast gleichmässig cylindrisch, mit Ausnahme des verdünnten Kopf- und Schwanzendes. Ersteres besonders im Cervicaltheile sehr dünn, nach vorn wieder etwas anschwellend, quer abgestutzt endigend. Das Hinterende zugespitzt mit durchbohrter Papille." . . . . . .

" *Auge* im Cervicaltheil kurtz hinter der Mundöffnung, scheint ringförmig den Oesophagus zu umgeben, von schön brauner Farbe, enthält zwei kleine runde Linsen.

" *Länge* des Männchens 5 Mm., Breite 0·10.

" Oesophagus=ein Fünftel der Körperlänge."

3. E. ACUMINATUM, Eberth.

Unters. über Nemat. p. 24, tab. iii. figs. 4, 5.

" *Körper* des Männchens fast gerade, cylindrisch, nach unten wenig an Dicke zunehmend, wenig verschmälert gegen das Vorderende, das Hinterende leicht eingebogen, in eine feine Spitze auslaufend, die in eine durchbohrte Papille endigt. . . . . Hinter dem Pharynx ein schwarzbrauner birnförmiger Pigmenthaufen, dessen vorderer verschmälerter Partie drei grössere runde Linsen aufliegen . . . .

" *Länge* des Männchens 3 Mm., Breite 0·1.

" Oesophagus=ein Fünftel der Körperlänge."

4. E. SUBROTUNDUM.

Enoplus subrotundus, Eberth. Unters. über Nemat. p. 33, tab. ii. figs. 11, 12.

" *Körper* des Männchens fadenförmig, Hinterende zugespitzt mit feiner durchbohrter Endanschwellung, Vorderende wenig verschmälert, abgerundet, in einen rundlichen, vom übrigen Körper leicht abgesetzten Kopf geendigt.

" *Auge* gross länglichrund, hinter dem Pharynx gelegen, schön braun, mit einer grösseren kugligen centralen Linse.

" *Länge* des Männchens $5\frac{3}{4}$ Mm., Breite 0·1 Mm.

" Oesophaguslänge verhält sich zur Körperlänge wie 1 : 6."

5. E. Grubii.

Grube, Ausflug nach Triest und dem Quarnero, 1861.—Eberth, Unters. über Nemat., p. 22.

17. ANTICOMA[1], Bastian.

Odontobius, Eberth.

Gen. Char. *Body* tapering at extremities. *Caudal sucker* rather small; sucker-tubes undeveloped. *Integument* plain; short rows of opposite setæ on lateral aspects of anterior extremity; also cephalic setæ, and others more or less scattered over posterior part of body of males; papillæ absent. *Pharyngeal cavity* none. *Œsophagus* not distinctly muscular, widening posteriorly, surrounded by *ring* near its middle. *Intestine* mostly covered with rather pale granules having a tessellated arrangement. *Vulva* about middle of body. *Uterus* bifid. *Spicules* two, curved. *Accessory piece* wanting. *Supplementary organ* small, simple, tubular. *Ocelli* absent. *Vaginal glands* two, pyriform, equal; *anal* two, medium-sized, nucleated. *Excretory ventral gland* opening opposite anterior of œsophagus. *Lateral canals* narrow, cellular. Movements moderately active.

1. A. Eberthi, n. sp. (Plate XI. figs. 143–145.)

Female, length $\frac{1}{4}''$, breadth $\frac{1}{166}''$.

External Characters.—Body whitish, slender, tapering considerably at extremities, especially at posterior, which is filiform. Head bluntly rounded, provided with a circlet of 6–8 well-marked setæ, whilst laterally, at a distance of $\frac{1}{666}''$ from anterior extremity, on each side, there is a row of 5 or 6 setæ extending at right angles from body. Integument plain.

Œsophagus $\frac{1}{8}$th of total length, gradually widening posteriorly, embraced by ring near its middle. *Intestine* well covered with light-coloured tessellated fat-particles. *Anus* $\frac{1}{91}''$ from posterior extremity. *Vulva* considerably anterior to middle of body, $\frac{1}{10}''$ from anterior extremity. *Uterus* bifid; segments symmetrical. *Anal glands* two. *Excretory ventral duct* opening opposite termination of anterior $\frac{1}{3}$rd of œsophagus.

Male, length $\frac{1}{5}''$, breadth $\frac{1}{200}''$.

Posterior extremity having a well-marked row of setæ in mid-abdominal region, above and below anus. *Anus* $\frac{1}{133}''$ from posterior extremity. *Spicules* curved, pointed, enlarged at upper extremities. *Supplementary organ* $\frac{1}{285}''$ above anal cleft, oblique, simple, tubular, $\frac{1}{1666}''$ long.

Hab. About the roots of *Corallina officinalis*, tide-pools, Falmouth.

2. A. limalis, n. sp. (Plate XI. figs. 146–148.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{227}''$.

External Characters.—Body whitish, tapering considerably anteriorly, and also at posterior extremity, which is rather long and filiform. Head slightly rounded, provided with a circlet of 4–6 spreading setæ; opposite cervical hairs not recognized. Integument plain or with the appearance of longitudinal markings about $\frac{1}{9000}''$ apart.

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[1] ἀντίος, *opposite*, and κόμη, *hair*, on account of the opposite rows of setæ on the lateral aspects of the cervical region.

Œsophagus $\frac{1}{5}$th of total length, gradually widening posteriorly, embraced by *ring* slightly in front of middle. *Intestine* covered with pale, regularly tessellated fat-cells. *Anus* $\frac{1}{118}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Uterus* bifid. *Vaginal glands* two, equal, pyriform. *Excretory ventral gland* opening close to anterior extremity, at a distance from it of only $\frac{1}{1666}''$.

Male, not seen.

Hab. Marine surface-mud of estuary, Falmouth.

Not having seen the male of this species, I do not feel quite certain that it belongs to this genus.

3. A. PELLUCIDA, n. sp. (Plate XI. figs. 149, 150.)

Female, length $\frac{1}{9}''$, breadth $\frac{1}{222}''$.

External Characters.—Body tapering considerably forwards, posterior extremity long and filiform. Head slightly rounded, provided with 4–6 setæ; whilst laterally, at $\frac{1}{666}''$ from anterior extremity, on each side, is a row of six short equidistant setæ. Integument with an appearance of longitudinal markings $\frac{1}{7000}''$ apart.

Œsophagus about $\frac{1}{5}$th of total length, widening posteriorly, and embraced by *ring* slightly anterior to its middle. *Intestine* covered with light, distinctly tessellated hepatic particles. *Anus* $\frac{1}{105}''$ from posterior extremity. *Vulva* slightly anterior to middle of body. *Anal glands* two. *Excretory ventral duct* . . .

Male, not seen.

Hab. Small green weed from tide-pools, Falmouth.

4. A. ACUMINATA.

Odontobius acuminatus, Eberth, Unters. über Nemat. p. 28, tab. i. figs. 6–9.

"*Körper* des Wiebchens weisslich, gerade. Vorderende stark verschmälert, Mund leicht abgerundet, Hinterende stark verdünnt, in einen geraden pfriemenförmigen Schwanz auslaufend.

"*Körper* des Männchens, Hinterende wie beim Weibchen. Zwei paarige, gekrümmte, leicht blassgelbe Spicula, davor ein unpaares, stabförmiges, accessorisches Glied. . . . . .

"Weibchen 2·5 Mm. lang, 0·1 Mm. breit.

"Männchen 2 Mm. lang, 0·075 Mm. breit.

"Oesophagus = ein Drittel der Körperlänge."

18. PHANODERMA[1], Bastian.

Enoplus, Eberth.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* well developed; sucker-tubes three, rather short. *Integument* plain, or with longitudinal markings, very transparent; cephalic *setæ* present; integumental pores well marked anteriorly, lateral.

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[1] φανὸς, *bright* or *clear*, and δέρμα, *skin*.

Pharyngeal cavity indistinct, with obscure indications of three slightly coloured pharyngeal plates. *Œsophagus* not distinctly muscular, widening posteriorly, surrounded by a *ring*, and in its latter half having circular contractions of its sheath at intervals, giving its border a regular crenated appearance; three longitudinal rows of orange- or other coloured pigment-granules more or less marked along its whole extent. *Intestine* covered with somewhat olive-coloured fat-particles, having a tessellated arrangement. *Vulva* about middle of body. *Uterus* bifid; segments symmetrical. *Spicules* two, long and narrow; *accessory piece* wanting. *Supplemental organ* small, obliquely situated, tubular. *Ocelli* two, large, conical, bright red, situated laterally. *Parietal glands*, on muscles, well developed. *Excretory ventral gland* consisting of a short tube, with a blind dilated extremity, and opening by an abruptly narrowed duct near anterior extremity. *Lateral canals* distinctly cellular.

Movements active.

1. P. COCKSI[1], n. sp. (Plate XI. figs. 151–153.)

Female, length $\frac{1}{4}''$, breadth $\frac{1}{144}''$.

External Characters.—Body tapering very gradually forwards, but narrowing quickly to a point behind, where it terminates in a well-developed sucker. Head narrow, rounded, provided with a circlet of 6–8 setæ; a few others scattered over anterior part of body. Integument hyaline, with an appearance of longitudinal markings $\frac{1}{12000}''$ apart.

Pharyngeal cavity indistinct. *Œsophagus* about $\frac{1}{5}$th of total length, embraced by *ring* at termination of anterior third; having three rows of pigment, varying from orange-colour to olive-green, along its whole length; constrictions of posterior half at regular intervals, giving a crenated appearance to borders. *Intestine* well covered with a tessellation of hepatic particles. *Anus* $\frac{1}{143}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Parietal glands* in œsophageal part of body very abundant. *Ocelli* two quite lateral, conical, bright-red pigment-masses. *Excretory ventral gland* opening by narrow duct, only $\frac{1}{250}''$ from anterior extremity, and terminating in a dilated extremity near the middle of œsophagus.

Male, length $\frac{1}{7}''$, breadth $\frac{1}{222}''$.

Anus $\frac{1}{200}''$ from posterior extremity. *Spicules* long, narrow, solitary; length $\frac{1}{125}''$. *Supplementary organ* tubular, not very distinct, slightly curved, $\frac{1}{666}''$ in length, and situated $\frac{1}{66}''$ above anus.

Hab. About the roots of Corallines in tide-pools, Falmouth.

2. P. ALBIDUM, n. sp. (Plate XI. figs. 154, 155.)

Female, length $\frac{1}{7}''$, breadth $\frac{1}{250}''$.

External Characters.—Body white, tapering gradually at extremities, not suddenly at posterior, as in last; terminating in distinct sucker, with which are connected three sucker-tubes. Head narrowed, rounded, having a circlet of 6–8 spreading cirri. Integument very hyaline and transparent.

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[1] Named after my dear and valued friend, W. P. Cocks, Esq., to whom science is much indebted for his researches into the marine zoology of Falmouth, resulting as they did in the discovery of so many new species of animals.

Pharyngeal cavity indistinct. *Œsophagus* $\frac{1}{5}$th and $\frac{1}{4}$th of total length, embraced by a *ring*; border of posterior half crenated. *Intestine* well covered with fat-particles, arranged in a tessellate manner. *Anus* $\frac{1}{154}''$ from posterior extremity. *Vulva* somewhat posterior to middle of body. *Ocelli* lateral, bright red, situated about $\frac{1}{666}''$ from anterior extremity. *Parietal glands* well developed. *Excretory ventral duct* . . . . . .

Male, not seen.

Hab. Small green sea-weed from tide-pools, Falmouth.

3. P. TUBERCULATUM, Eberth.

Enoplus tuberculatus, Eberth, Untersuch. uber Nemat. p. 38, tab. iv. figs. 1–5.

"*Körper* fast gerade, nach hinten anschwellend, nach vorn sich allmählich verschmälernd, mit quer abgestutztem Kopf. Schwanz kurz, wenig spitz, in eine durchbohrte Papille endigend. Das Männchen vor Beginn des Schwanzes stärker anschwellend . . . . . .

"Länge des Weibchens 5 Mm., Breite 0·2 Mm.

"Länge des Männchens $4\frac{1}{2}$ Mm., Breite 0·125 Mm.

"Oesophaguslänge verhält sich zur Körperlänge wie 1 : 3."

19. LEPTOSOMATUM[1], Bastian.

Phanoglene, Eberth; *Enoplus*, Eberth.

GEN. CHAR. *Body* elongated, filiform; posterior extremity blunt and rounded. *Caudal sucker* not prominent, provided with two or three long sucker-tubes. *Integument* plain or with longitudinal markings; lateral integumental pores well marked; setæ absent, or very few in number; cephalic papillæ wanting. *Pharyngeal cavity* wanting. *Œsophagus* not distinctly muscular, almost uniform in size, and surrounded anteriorly by an œsophageal *ring*. *Intestine* very scantily covered with small light-coloured fat-particles, sometimes almost altogether wanting. *Vulva* considerably posterior to middle of body. *Uterus* bifid; segments symmetrical (?). *Spicules* two, rather broad, but tapering at extremities. *Accessory pieces* two, posterior, somewhat cuneiform. *Supplemental organ* occasionally present. *Suckers* also occasionally present in male, above anus. *Ocelli* two, conical, red, almost lateral, having occasionally a transparent lens-shaped body imbedded in their substance anteriorly. *Excretory glands* two, lateral, opening on either side close to anterior extremity, and reaching nearly to posterior part of œsophagus. *Lateral canals* . . . . . .

Movements mostly slow and tardy.

I feel by no means certain that the animals here placed in this genus all really belong to the same type, and may not later require a rearrangement. The three species found by me undoubtedly present certain common characters, the most notable of which are the similarity in the shape of the male spicules and accessory pieces, as well as in the nature of the ocelli; but I have unfortunately been unable to ascertain whether *Leptosomatum gracile* and *L. figuratum* have the same double excretory glands as I have unmistakeably made out in the typical species *L. elongatum*; in both these other two species I have as yet failed to detect any structure, either simple or double, answering to the excretory gland.

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[1] λεπτὸς, *slender*, and σῶμα, *a body*.

After a careful examination of Eberth's figures, however, I feel almost sure that his *Phanoglene punctata* presents the same type of structure[1] as my *L. elongatum*, and still more convinced that his *P. bacillata* is intimately allied to *L. gracile*. Whether belonging to this or more correctly to another, it is also evident that his *Enoplus coronatus* and my *L. figuratum* must be included in the same genus.

I have constituted this new genus, and removed from the genus *Phanoglene* the species placed in it by Eberth, on account of the improbability that these marine forms would agree in structure with the freshwater type of Nordmann's genus.

1. L. ELONGATUM, n. sp. (Plate XII. figs. 156, 157.)

Male, length $\frac{2}{5}''$, breadth $\frac{1}{200}''$.

External Characters.—Body cylindrical, filiform, tapering but very slightly at extremities. Sucker not prominent; sucker-tubes two, long, tubular, the terminations being blunt and rounded. Head slightly narrowed, rounded, naked. Integument plain; no striæ visible.

Œsophagus $\frac{1}{7}$th of total length, slender, nearly uniform in size, and free from pigment, surrounded by *ring* near end of anterior third. *Intestine* scarcely recognizable, from the almost total absence of hepatic particles. *Anus* $\frac{1}{285}''$ from posterior extremity. *Spicules* $\frac{1}{25}''$ long, broad in the middle, but tapering at extremities; *accessory pieces* $\frac{1}{1000}''$ long. *Ocelli* two conical carmine-coloured masses on dorsum of œsophagus, $\frac{1}{285}''$ from anterior extremity. *Excretory glands* two, tubular, extending along anterior two-thirds of œsophagus, and opening one on each side of head, $\frac{1}{1000}''$ from level of anterior extremity.

Female, not seen.

Hab. In a small dull-reddish sponge between crevices of stones from estuary, Falmouth.

2. L. PUNCTATUM.

Phanoglene punctata, Eberth, Untersuch. über Nemat. p. 20, tab. ii. figs. 5–7.

" *Körper* überall von fast gleicher Dicke, stärker verschmälert nach vorn, hinten in eine stumpfe Spitze auslaufend, leicht gegen den Bauch concav, mitunter auch stärker eingerollt. Das terminale Ende hier und da leicht nach unten eingebogen. Hinterende des Männchens etwas schmäler als das vom Weibchen. Mundöffnung eine leichte Grube, kurz hinter ihr auf der Bauch- und Rückenfläche zwei kleine Haare . . . . . .

"Weibchen 4·5 Mm. lang, 0·10 Mm. breit. Männchen 7·5–8 Mm. lang, 0·1 Mm. breit.

"Oesophagus=ein Fünftel der Körperlänge.

"*Hab.* Villafranca, unter Seepflanzen."

3. L. GRACILE, n. sp. (Plate XII. figs. 158–160.)

Female, length $\frac{1}{2}''$, breadth $\frac{1}{133}''$.

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[1] Although he merely represents a terminal portion of one excretory gland, and does not depict its commencement anteriorly, I think he has very possibly overlooked the other, and also the lateral openings so close to the anterior extremity. This very unusual arrangement seems not to have been detected by him.

External Characters.—Body white, long, thread-like, tapering very slightly at extremities. Head rounded and, as well as rest of body, naked. Integument plain; pores very numerous and easily recognizable, especially in lateral regions of anterior extremity.

Œsophagus $\frac{1}{9}$th of total length, embraced by ring anteriorly, very slightly pigmented, and almost uniform in size. *Intestine* sparingly covered with small light-coloured granules more or less tessellate in arrangement. *Anus* $\frac{1}{182}''$ from posterior extremity. *Vulva* posterior to middle of body. *Uterus* bifid; segments symmetrical. *Ova* very large, occupying whole width of body. *Excretory glands* . . . . . . *Ocelli* two, bright red, conical, on dorsum of œsophagus, $\frac{1}{222}''$ from posterior extremity.

Male, length $\frac{1}{3}''$, breadth $\frac{1}{182}''$.

Anus $\frac{1}{182}''$ from posterior extremity. *Spicules* $\frac{1}{333}''$ long, same shape as in *L. elongatum*; *accessory pieces* about half as long as spicules.

Hab. Same as *L. elongatum*.

4. L. BACILLATUM.

Phanoglene bacillata, Eberth, Unters. über Nemat. p. 19, tab. ii. figs. 1–4.

"*Körper* des Weibchens gerade, gegen die Mitte wenig anschwellend, beide Enden fast gleichmässig verdünnt, Vorderende leicht gerundet, quer abgestutzt, Hinterende stumpf, mit terminaler Oeffnung für die Schwanzdrüse. . . . . . .

"Weibchen 8–9 Mm. lang, 0·1 Mm. breit.

"Oesophaguslänge=ein Fünftel des Körpers.

"*Hab.* Unter Corallen im Hafen von Nizza."

5. L. FIGURATUM, n. sp. (Plate XII. figs. 161–163.)

Female, length $\frac{1}{3}''$, breadth $\frac{1}{166}''$.

External Characters.—Body long, cylindrical, scarcely tapering at all at extremities, the posterior being blunt and rounded. Sucker well developed; sucker-tubes large. Head bluntly rounded, of a light yellowish colour for about $\frac{1}{666}''$ of an inch, and figured in a regular manner by bright lines; provided with a circlet of four short conical setæ. Integument with an appearance of longitudinal markings; integumental pores lateral.

Œsophagus about $\frac{1}{5}$th of total length, nearly uniform in size, embraced by *ring* about the termination of anterior third. *Intestine* rather slightly covered with light fat-particles not tessellately arranged. *Anus* $\frac{1}{285}''$ from posterior extremity. *Vulva* at commencement of posterior third of body. *Uterus* bifid; segments short, symmetrical. *Ocelli* two lateral, reddish brown, conical pigment-masses, each having a transparent lens-like body imbedded anteriorly. *Floating gland-cells* very large, oval, nucleated, often at regular distances on either side of body. *Excretory glands* indistinct; appearance of lateral openings at either side of head; nothing else recognized.

Male, very slightly smaller than female.

Anus $\frac{1}{285}''$ from posterior extremity. *Spicules* $\frac{1}{200}''$ in length; *accessory pieces* $\frac{1}{285}''$ long. *Supplementary organ* in the form of a horny sucker-like body, $\frac{1}{333}''$ above anus.

A series of nine hemispherical prominences above anus, on either side of middle line (suctorial papillæ).

Hab. About the roots of *Corallina officinalis*, and in sponge with *L. elongatum* and *L. gracile*, Falmouth.

6. L. CORONATUM.

Enoplus coronatus, Eberth, Unters. über Nemat. p. 37, tab. iii. figs. 13–19.

"*Körper* bei dem Weibchen fast gerade, stärker verschmälert gegen das Kopfende, weniger gegen den Schwanz.

"Kopf leicht abgerundet mit einer kleinen centralen Vertiefung, die zum Pharynx führt. Hinterende stumpf spitz, bei dem Männchen leicht eingerollt.

"Länge des Weibchens 5 Mm., Breite 0·20 Mm.

"Länge des Männchens 4–5 Mm., Breite 0·2 Mm.

"Oesophaguslänge verhält sich zur Körperlänge wie 1 : 5.

"*Hab.* Unter Corallen im Hafen von Nizza."

7. L. LONGISSIMUM.

Phanoglene longissimum, Eberth, Unters. über Nemat. p. 21, tab. ii. fig. 8.

"*Körper* des Weibchens eingerollt, nach unten anschwellend, Vorderende ziemlich schmal, Hinterende wenig verschmächtigt, stumpf.

"*Sinnesorgane.* In der Cervicalgegend zwei viereckige hellbraune Pigmentflecke ohne deutliche Linse.

"Weibchen 15 Mm. lang, $\frac{1}{4}$ Mm. breit.

"Oesophagus verhält sich zur Körperlänge wie 1 : 15.

"*Hab.* Unter Corallen im Hafen von Nizza."

8. L. SUBULATUM.

Phanoglene subulata, Eberth, Unters. über Nemat. p. 21, tab. ii. figs. 9 & 10.

"*Körper* des Weibchens in der äussern Form der vorigen Art (*L. longissimum*), mit Ausnahme des Schwanzes, ganz ähnlich. Dieser war hier sehr lang, pfriemenförmig und endete in eine schmale durchbohrte Papille.

"Länge etwa 8 Mm.

"*Hab.* Nizza."

This species seems to differ considerably from the others; and the form of the tail, with the presence of anal glands, as represented by Eberth, are sufficient to indicate the improbability of its really belonging to this genus.

20. ENOPLUS, Dujardin.

Lineola, Kölliker.

GEN. CHAR. *Body* tapering at extremities, especially towards posterior, which is more or less conical. *Caudal sucker* of moderate size, generally provided with three short sucker-tubes. *Integument* having transverse and longitudinal markings; pores most visible in mid-dorsal and ventral region; cephalic setæ generally present, and others frequent about posterior extremity, especially in the male; cephalic papillæ often present. *Pharyngeal cavity* none or indistinct, but in its situation three distinct horny jaws or teeth, more or less bilobed at their extremities. *Œsophagus* not distinctly muscular, nearly uniform in size, often much stained with pigment, especially at the anterior part; no distinct œsophageal ring. *Intestine* well covered with dark pigment-granules often distinctly tessellate in arrangement. *Vulva* about middle of body. *Uterus* bifid; segments symmetrical. *Spicules* large, curved, and, together with two strong lateral *accessory pieces*, of a yellowish-brown colour. *Supplemental organ* of same colour, large, oblique, funnel-shaped. *Ocelli* (pseud.) occasional, owing to more distinct aggregation of the usual pigment-matter of œsophagus; sometimes on or external to œsophageal sheath (?). *Excretory ventral gland* tubular, opening about the termination of anterior third of œsophagus. *Lateral canals* distinctly cellular.

Movements moderately active.

This is a very interesting genus, inasmuch as it appears to reveal to us the most rudimentary condition of the ocelli, which are found more specially developed in the species of other genera, such as *Phanoderma* and *Leptosomatum*. Here we find, in several species, a simple local increase in the aggregation of the pigment, in two or three patches, on the anterior part of the œsophagus, it being also more or less scattered over its whole extent, whilst in *Enoplus inermis* it is wanting in all parts of the œsophagus, save in two rather distinctly defined ocelli-like masses, which seem, however, to be still situated beneath instead of on the sheath of the œsophagus, as is so evidently their situation in the genera above named.

In this genus also are included many species of free Nematodes which have been discovered by other observers, but whose real position and nature are still very doubtful, either from the insufficient or unsatisfactory nature of the details concerning them.

1. E. COMMUNIS, n. sp. (Plate XII. figs. 164–166.)

Female, length $\frac{1}{4}''$, breadth $\frac{1}{120}''$.

External Characters.—Body tapering slightly forwards, but considerably behind, where it terminates in a rather long pointed extremity, with a rounded sucker and three small divergent setæ. Head rounded, narrowed, provided with four crucially arranged papillæ, and behind them a circlet of 8–10 long patent setæ; a few small setæ scattered over anterior part of body also. Integument with almost imperceptible transverse striæ, about $\frac{1}{30000}''$ apart, and with an appearance of longitudinal markings also at a distance of $\frac{1}{8000}''$.

Pharynx indistinct. *Teeth* three, equal-sized, of a light fawn-colour, $\frac{1}{1000}''$ long, marked with minute longitudinal lines, and having their upper extremities somewhat bilobed. *Œsophagus* about $\frac{1}{8}$th of total length, having its canal indicated by a sinuous line, with irregular transverse markings of its walls at intervals, and a more or less abundant arrangement of minute olive-coloured pigment-granules, mostly collected in three longitudinal lines, with short irregular transverse offshoots or separate masses, most marked anteriorly just behind pharynx. *Intestine* thickly covered with dark-coloured fat-particles contained in rather large cells, the tessellated appearance being distinct. *Anus* $\frac{1}{77}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Excretory ventral gland* tubular, extending from posterior part of œsophagus to about the termination of anterior third.

Male, length $\frac{1}{4}''$, breadth $\frac{1}{100}''$.

Rather stouter than female, especially at posterior extremity; tail tapering more abruptly behind anus; small setæ scattered over posterior part of body; below anal cleft are two strong setæ, one on each side of middle line; and above, between it and supplementary organ, is a single median row of about sixteen longer and more slender bristles. Strong obliquely transverse markings of integument $\frac{1}{3500}''$ apart for some distance above anal cleft.

Spicules brownish yellow, strong, curved, $\frac{1}{100}''$ in length; *accessory pieces* of same colour, $\frac{1}{222}''$ long, slightly curved, and somewhat wedge-shaped. *Supplementary organ* $\frac{1}{66}''$ above anus, brownish yellow, large, infundibuliform, $\frac{1}{200}''$ long; internal expanded portion becoming thin and rather indistinct.

Hab. About the roots of *Corallina officinalis* from tide-pools, Falmouth.

2. E. Dujardinii, n. sp. (Plate XII. figs. 168–170.)

Female, length $\frac{1}{4}''$, breadth $\frac{1}{100}''$.

External Characters.—Body very pellucid, tapering slightly anteriorly, but considerably behind anus. Head narrowed, rounded, having four crucially arranged papillæ around mouth, and behind these a circlet of 10–12 strong patent setæ; no other setæ visible. Integument very transparent, with almost imperceptible transverse and also longitudinal markings.

Teeth three, same as in last. *Œsophagus* between $\frac{1}{6}$th and $\frac{1}{7}$th of total length; pigment-lines and markings well developed anteriorly, but no very distinct local aggregations. *Intestine* broad, densely covered with small, dark-coloured, tessellate aggregations of fat-particles only about $\frac{1}{2000}''$ in diameter. *Anus* $\frac{1}{60}''$ from posterior extremity. *Vulva* very slightly posterior to the middle of body. *Excretory ventral duct* opening opposite termination of anterior third of œsophagus.

Male, about same size as female, but slightly narrower. Posterior extremity terminating with three minute setæ; single median row of long narrow setæ between anus and supplementary organ; the two posterior to anus not present, neither were any small ones scattered over posterior part of body recognized.

Spicules brownish yellow, strong, curved, $\frac{1}{125}''$ long; *accessory pieces* about half as long. *Supplementary organ* $\frac{1}{77}''$ above anus, much longer, as compared with breadth of body, than in last species.

Hab. In sand and about roots of Algæ from tide-pools, Falmouth.

3. E. pigmentosus, n. sp. (Plate XII. figs. 171, 172.)

Female, length $\frac{1}{3}''$, breadth $\frac{1}{100}''$.

External Characters.—Body tapering slightly forwards; posterior extremity behind anus elongated, conical, terminating with distinct rounded sucker, but no setæ. Head bluntly rounded; mouth surrounded by four rather smaller papillæ; and behind them is a circlet of about six strong spreading setæ; no setæ recognized on other parts of body. Integument transparent; striæ not recognized.

Teeth three, large, $\frac{1}{666}''$ in length. *Œsophagus* about $\frac{1}{7}$th of total length, abundantly marked with pigment arranged in three principal rows. *Intestine* densely covered with very dark-coloured and almost black pigment-granules; tessellate arrangement not very distinct. *Anus* $\frac{1}{160}''$ from posterior extremity. *Vagina* anterior to middle of body. *Ova* large. *Excretory ventral duct* opening opposite termination of anterior third of œsophagus.

Male, not seen.

Hab. About roots of Algæ and Corallines from tide-pools, Falmouth.

4. E. INERMIS, n. sp. (Plate XII. figs. 173–175.)

Female, length $\frac{1}{3}''$, breadth $\frac{1}{187}''$.

External Characters.—Body naked, tapering but very slightly anteriorly, though in the usual way towards posterior extremity, which terminates in a rather undeveloped sucker, in connexion with which the usual sucker-tubes were not recognized. Head bluntly rounded, or even somewhat angular; no papillæ; no setæ. Integument with faint transverse striæ, $\frac{1}{10000}''$ apart, and also indistinct longitudinal markings.

Teeth three, small, $\frac{1}{3333}''$ long, very close to mouth. *Œsophagus* about $\frac{1}{7}$th of total length, almost free from pigment, except anteriorly, where it is principally collected into two reddish-brown *ocelli-like* masses, about $\frac{1}{333}''$ from anterior extremity. *Intestine* well covered with dark pigment-granules; tessellation indistinct. *Anus* $\frac{1}{66}''$ from posterior extremity. *Vulva* posterior to middle of body. *Excretory ventral gland* could not be detected.

Male, length nearly the same as that of female, breadth $\frac{1}{143}''$. Head provided with four indistinct papillæ; posterior extremity broader than in female, and tapering more abruptly behind anus; two setæ below anus, small; no other seen.

Spicules brownish yellow, curved, obtuse at points, $\frac{1}{166}''$ long; *accessory pieces* of about half the length. *Supplementary organ* rather narrow, $\frac{1}{80}''$ above anus, and $\frac{1}{200}''$ in length.

Hab. In small red sponges from crevices of rock, Falmouth.

5. E. BREVIS, n. sp. (Plate XII. figs. 176, 177.)

Female, length $\frac{1}{5}''$, breadth $\frac{1}{143}''$.

External Characters.—Body scarcely tapering at all anteriorly, but considerably towards the posterior extremity, which is rather long and pointed, terminating in a distinct sucker; sucker-tubes not recognized. Head rounded, having no papillæ, but provided with a circlet of 10–12 setæ. Integument transparent, with very delicate transverse and longitudinal markings.

Teeth three, large, $\frac{1}{166}''$ in length. *Œsophagus* between $\frac{1}{5}$th and $\frac{1}{6}$th of total length; pigmentary deposits distinct almost to termination. *Intestine* well covered with dark-coloured fat-particles, having a tessellate arrangement. *Anus* $\frac{1}{80}''$ from posterior extremity. *Vulva* posterior to middle of body. *Excretory ventral duct* opening at $\frac{1}{100}''$ from anterior extremity.

Male, not seen.

Hab. About roots of small Algæ and Corallines from tide-pools, Falmouth.

6. E. TRIDENTATUS, Dujardin.

Hist. Nat. des Helminthes, p. 233.

"Corps filiforme, gris-brunâtre, long de 3 à 7^{mm}, large de $0^{\mathrm{mm}}\cdot 11$ à $0^{\mathrm{mm}}\cdot 23$, trente à trente-cinq fois aussi long que large; tête anguleuse, large de $0^{\mathrm{mm}}\cdot 06$, portant latéralement quelques soies roides, opposées; bouche ronde, entourée par le tégument mou, et armée intérieurement de trois mâchoires cornées, symétriques; mandibules longues de $0^{\mathrm{mm}}\cdot 046$, formées d'une apophyse postérieure, plus étroite, élargies et bilobées en avant, où elles se terminent par une dent crochue interne; œsophage musculeux, long de $0^{\mathrm{mm}}\cdot 9$, large de $0^{\mathrm{mm}}\cdot 063$, avec des bandes transverses de pigment brun-rougeâtre; deux amas de pigment rouge (taches oculiformes?) à l'origine de l'œsophage; canal œsophagien triquêtre, à bord flexueux; intestin revêtu de plaques aréolées brunâtres (foie?); tégument formé d'un épiderme épais de $0^{\mathrm{mm}}\cdot 0017$, et de huit à neuf couches d'une substance diaphane élastique.

"*Mâle* ayant la partie postérieure du corps hérissée de quelques soies éparses; queue assez brusquement amincie, large de $0^{\mathrm{mm}}\cdot 02$, à l'extrémité; orifice génital (et anal?) à $0^{\mathrm{mm}}\cdot 31$ de l'extrémité; un autre orifice (anus ou ventouse?) situé à $0^{\mathrm{mm}}\cdot 35$ en avant; spicules épais, longs de $0^{\mathrm{mm}}\cdot 15$, courbés en faucille et dentelés vers l'extrémité; pièce accessoire longue de $0^{\mathrm{mm}}\cdot 048$, embrassant l'extrémité des spicules.

"*Femelle* à queue plus longue et moins brusquement amincie; anus à $0^{\mathrm{mm}}\cdot 47$ de l'extrémité; vulve orbiculaire, située en avant du milieu.

"Je l'ai trouvé fréquemment entre les algues marines à Toulon, et à Cette dans la Méditerranée, et dans l'étang de Thau, et à Saint-Malo dans l'Océan."

7. E. STENODON, Dujardin.

Hist. Nat. des Helminthes, p. 234.

"Corps long de 2^{mm} à (?), large $0^{\mathrm{mm}}\cdot 04$ à (?), cinquante fois environ aussi long que large; tête large de $0^{\mathrm{mm}}\cdot 013$, munie de quelques soies roides, latérales; bouche armée intérieurement de trois dents étroites, sinueuses, longue de $0^{\mathrm{mm}}\cdot 012$: une tache rouge bien nette sur l'œsophage, à $0^{\mathrm{mm}}\cdot 03$ de la bouche; queue épaisse, amincie peu à peu; anus à $0^{\mathrm{mm}}\cdot 07$ de l'extrémité.

"Dans l'eau de mer entre les algues, à Lorient."

8. E. ELONGATUS, Dujardin.

Hist. Nat. des Helminthes, p. 234.

"Corps long de 18^{mm}, large de $0^{\mathrm{mm}}\cdot 2$, quatre-vingt-dix fois aussi long que large; tête large de $0^{\mathrm{mm}}\cdot 06$, tronquée et munie de soies latérales roides, assez longues; bouche armée intérieurement de deux ou trois pièces (mâchoires) coudées, à angle droit en avant et en dedans, et dentelées en avant.

"Dans l'eau de mer, à Saint-Malo."

9. E. MICROSTOMUS, Dujardin.

"Corps proportionnellement assez épais, long de $2^{\mathrm{mm}}\cdot 6$, large de $0^{\mathrm{mm}}\cdot 10$, vingt-six fois aussi long que large, aminci seulement aux extrémités; tête amincie brusquement et large $0^{\mathrm{mm}}\cdot 016$ en avant, et entourée de quelques soies roides; bouche armée intérieurement de trois pièces (mâchoires?) prolongées par des apophyses étroites en arrière; deux taches rouges bien nettes et bien séparées, à $0^{\mathrm{mm}}\cdot 06$ de la bouche; queue courte, assez brusquement amincie.

"Dans l'eau de mer, à Lorient."

10. E. MACROPHTHALMUS, Eberth.

Unters. über Nemat. p. 35, tab. ii. figs. 23, 24, tab. iii. fig. 6.

"*Körper* des Weibchens fast gerade, gegen das Vorderende wenig verschmälert, das Schwanzende stärker zugespitzt und in eine kleine durchbohrte Anschwellung endigend.

"Kopf abgerundet mit einem mittleren rundlichen Vorsprung und 2 kleinen seitlichen Papillen.

"Zwei grosse braune Pigmentflecken hinter dem Pharynx.

"Weibchen 5 Mm. lang, 0·20 Mm. breit.

"Oesophaguslänge$=\frac{1}{5}$ Körperlänge."

11. E. OBTUSICAUDATUS, Eberth.

Untersuch. über Nemat. p. 36, tab. iii. figs. 7 & 8.

"*Körper* des Weibchens.—In seiner äusseren Form ist er von dem vorigen verschieden durch die allmähliche und geringe Verschmälerung des Vorderendes und durch den stumpfen Schwanz, welcher nach oben eine mehr concave und nach unten eine mehr convexe Fläche bildet. Am Schwanze eine terminale nur leicht prominirende Mündung der Schwanzdrüse.

"Hinter dem Pharynx zwei quergelagerte dunkelbraune Augenflecke.

"Länge des Weibchens 3 Mm., Breite 0·125 Mm.

"Oesophaguslänge$=\frac{1}{6}$ der Körperlänge."

12. E. STRIATUS, Eberth.

Unters. über Nemat. p. 36, tab. ix. figs. 9–12.

"*Körper* fast gerade, fadenförmig, in der Mitte angeschwollen, gegen die beiden Enden verschmälert, stärker gegen den Schwanz; dieser bei dem Männchen leicht eingebogen. Vorderende stumpf abgerundet, mit einem kleinen trichterförmigen Mund. Der Körper hinter dem Pharynx auf eine kurze Strecke leicht eingeschnürt . . . . . .

"Hinter dem Pharynx zwei braune nierenförmige Pigmenthaufen.

"Länge der Männchen 3 Mm., Breite 0·125 Mm.

"Oesophaguslänge$=\frac{1}{6}$ der Körperlänge."

13. E. OCULATUS, Diesing.

Revision der Nematoden, Sitzungsb. der Wien. Akad. 1861, Bd. xlii. no. 28, p. 625.
Anguillula oculata, Oersted, De region. marin., 1844.

"Ocelli duo brunnei."

"*Hab.* In profunditate $11-\infty$ orgyarum, Kullen in fretu Öresund, æstate (*Oersted*)."

14. E. **Leydigii**, Eberth.

Müller's Archiv, 1851, p. 292.—Eberth, Unters. über Nemat. p. 32.

"Der Wurm ist fadenförmig, 1½–2‴ lang, das Kopfende breiter als das Schwanzende. Die cuticula stark quergeringelt, besonders im vorderen Drittheil des Körpers, und jeder Ring erscheint wieder für sich längsgestrichelt.

"Kopf querabgestutzt, vorderer Rand wie lippenartig, mit mehren seichten Einkerbungen und mit vereinzelten blassen Borsten besetzt. Der Lippentheil des Kopfes ist hell, sonst hat der Wurm bei durchfallendem Lichte eine bräunliche Farbung. Die Mundhöhle hat innen zwei seitliche gezähnelte Leisten und eine unpaare mittlere kleinere. Schundröhre nach hinten leicht kolbig angeschwollen, dickwandig, quergestreift mit innerer Cuticula. Darm gerade. Anus an der Schwanzbasis. Im Anfang des Oesophagus zwei rothbraune augenähnliche Flecke. Zwei entgegengesetzt verlaufende Eierstöcke, gemeinsamer Uterus, Vagina in der Mitte des Körpers. Das Männchen vor dem Schwanzende auf dem Rücken mit Borsten besetzt. Es scheinen zwei Spicula vorhanden. Schwanzdrüse bei beiden Geschlechtern durch ein kurzes Röhrchen mündend." —*Eberth.*

15. E. **Sieboldii**, Eberth.

Untersuch. über Nemat. p. 31.

Lineola Sieboldii, Kölliker, Abdrück aus den Verhand. d. Naturf. Gesellch. 1845.

"Der Leib ist bräunlich, vorn und hinten weiss, 3–5‴ lang. Von den Fühlern vier sehr kurtz, zwei etwas länger, alle endständig. Mundhöhle mit kleinen zahnartigen Hervorragungen besetzt; am Kopfe dicht am Oesophagus zwei oder drei Flecken (Augen?). Scheideöffnung mit zwei oder drei kleinen zahnartigen Vorsprüngen versehen. Schwanz 0·1‴ lang; Penis 0·1‴ lang."

16. E. **cirrhatus**, Eberth.

Untersuch. über Nemat. p. 34, tab. ii. fig. 20–22, tab. iv. fig. 17, & tab. v. fig. 4.

"*Körper*: bei dem Weibchen am Hinterleib gegen den Bauch leicht eingebogen, stärker eingerollt bei dem Männchen, beide Enden verschmälert, der Schwanz zugespitzt, das Vorderende etwas abgerundet. Schwanz in eine kurze durchbohrte Spitze auslaufend . . . . . .

"Länge des Weibchens 4 Mm., des Männchens 3½ Mm.

"Breite des Weibchens 0·12 Mm., des Männchens 0·1 Mm.

"Oesophaguslänge = $\frac{1}{6}$ der Körperlänge."

This certainly is not an *Enoplus*; the type is distinct, though unknown to me.

17. E. **cæruleus**, Eberth.

Untersuch. über Nemat. p. 39, tab. iv. fig. 6–12, & tab. v. fig. 3.

"*Körper* von bläulicher Färbung, cylindrisch, gegen das Vorderende leicht verschmälert und stumpf conisch geendet, das Hinterende wenig verjüngt, stumpf; beim Weibchen gegen den Bauch eingekrümmt, beim Männchen stärker eingerollt. Die Gestalt des Schwanzes bei beiden Geschlechtern gleich. An ihm findet sich terminal eine zeimlich grosse runde Oeffnung für die Schwanzdrüse. Kurz vor der Mündung liegen noch drei kleine hornige zahnartige Klappen. Die Drüse besteht aus einem grösseren, von einer gemeinsamen Membran eingeschlossenen Zellenaggregat . . . . . .

"Am unteren Ende des Pharynx liegen auf diesem zwei schönblaue nierenförmige Augen.

"Länge des Weibchens 6 Mm., Breite 0·2 Mm.

"Länge des Männchens 4 Mm., Breite 0·2 Mm.

"Oesophaguslänge verhält sich zur Körperlänge wie 1 : 5."

This also cannot belong to the genus *Enoplus*. The first glance at Eberth's figures reveals a large pharyngeal cavity with no teeth or jaws, a distinct œsophageal ring, and an absence of the characteristic supplementary male organ, which at once negative its really belonging to this genus. It seems to be a most remarkable and interesting type, but one with which I am quite unfamiliar.

18. E. QUADIDENTATUS, Berlin.

Müller's Archiv, 1853, p. 431.—Eberth, Untersuch. über Nemat. p. 31.

Under this name Berlin appears to have included two or three forms which are perfectly distinct from one another. From his drawings, one of these animals is undoubtedly an *Enoplus*, whilst another appears to be a *Leptosomatum*.

19. E. ——, n. sp., M. Schultze.

V. Carus, Icones Zootomicæ, pl. vii. fig. 3.

No description.

This animal is evidently not an *Enoplus*.

21. LINHOMŒUS[1], Bastian.

GEN. CHAR. *Body* linear, cylindrical, scarcely tapering at all at the extremities, which are blunt and rounded. *Caudal sucker* small, very slightly prominent; sucker-tubes two, short and broad. *Integument* plain or with longitudinal markings; lateral cervical mark circular, small, with a dot in the centre; setæ more or less abundant in anterior part of body; no cephalic papillæ. *Pharyngeal cavity* of moderate size, cup-shaped, naked. *Œsophagus* distinctly muscular, swollen slightly behind pharynx and again at termination. *Intestinal cells* containing rather light-coloured particles more or less tessellate. *Vulva* about the middle of body, with minute eminences (suckers?) in median line in front and behind it. *Uterus* bifid, segments symmetrical. *Spicules* curved, pointed. *Accessory pieces* two, thin and reflexed. *Ocelli* none. *Glandular system* parietal, not much developed; floating cells in general cavity of body large; anal glands well developed. *Excretory ventral gland* consisting of a broad duct opening near middle of œsophagus, and a terminal dilated portion pressing upon first part of intestine. *Lateral canals* indistinct.

Movements rather slow.

1. L. HIRSUTUS, n. sp. (Plate XII. figs. 178, 179.)

Female, length $\frac{1}{6}''$, breadth $\frac{1}{303}''$.

External Characters.—Body tapering scarcely at all at extremities, but rather more posteriorly than anteriorly. Head truncated or obtusely rounded, surrounded by setæ, some directed forwards and others spreading, the latter continuing for some distance over anterior part of body. Integument very thin; no markings visible.

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[1] λίνον, *a line*, and ὅμοιος, *like*, in allusion to the thread-like nature of the body.

Pharyngeal cavity cup-shaped, $\frac{1}{2000}''$ deep. *Œsophagus* $\frac{1}{11}$th of total length. *Intestine* well covered with cells presenting a tessellate arrangement, and containing light-coloured granules. *Vulva* slightly anterior to middle of body; seven minute suctorial eminences in median line before and behind it, about $\frac{1}{1000}''$ apart. *Anal glands* consisting of four distinct masses. *Excretory duct* opening near middle of œsophagus. *Lateral canals* faintly granular, occupying about $\frac{1}{6}$th of circumference of body.

Male, not seen.

Hab. In sand at roots of sea-weed from tide-pools, Falmouth.

2. L. ELONGATUS, n. sp. (Plate XII. figs. 180, 181.)

Male, length $\frac{3}{10}''$, breadth $\frac{1}{533}''$.

External Characters.—Body very long and filiform, not tapering at all anteriorly, and but very slightly immediately before termination. Head bluntly rounded, furnished with a circle of eight setæ, directed forwards. Integument thin, presenting longitudinal markings $\frac{1}{12000}''$ apart.

Pharyngeal cavity nearly rectangular, depth $\frac{1}{1500}''$, having three thin horny laminæ continued backwards (into substance of œsophagus), with rounded and minutely serrated edges. *Œsophagus* about $\frac{1}{6}$th of total length. *Intestine* covered with cells having a tessellate arrangement; individual cells containing rather few granules. *Anus* $\frac{1}{55}''$ from posterior extremity. *Spicules* of moderate length, curved; *accessory pieces* thin, flat, blade-like. *Anal glands* four large, somewhat quadrate, granular bodies, lying between anal cleft and sucker-tubes. *Excretory duct* opening near middle of œsophagus.

Female, not seen.

Hab. With *Symplocostoma tenuicollis* and *Chromadora vulgaris* on fine filamentous green weed from tide-pools, Falmouth.

22. TACHYHODITES[1], Bastian.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* very small; no sucker-tubes visible. *Integument* having transverse striæ; cephalic setæ present; papillæ absent. *Pharyngeal cavity* very small, indistinct. *Œsophagus* almost cylindrical. *Intestine* rather sparingly covered with light olive-coloured hepatic granules. *Vulva* posterior to centre of body. *Uterus* unsymmetrical. *Spicules* rather narrow, curved. *Accessory pieces* nearly straight, pointed, and directed backwards. *Ocelli* (?) two bright colourless bodies on upper surface of œsophagus. *Excretory ventral gland* . . . . . . *Lateral canals* . . . . . .

Movements very rapid.

1. T. NATANS, n. sp. (Plate XIII. figs. 182–184.)

Female, length $\frac{1}{88}''$, breadth $\frac{1}{666}''$.

External Characters.—Body tapering towards either extremity, but principally towards the posterior, which is sharp and filiform. Head bluntly rounded, furnished with a circlet of 4–6 short setæ. Integument having very fine transverse striæ, about $\frac{1}{30000}''$ apart.

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[1] ταχὺς, *swift*, and ὁδίτης, *a traveller*.

Pharyngeal cavity very small, conical. *Œsophagus* about $\frac{1}{6}$th of total length, enlarging very slightly backwards. *Intestine* sparingly covered with non-tessellate hepatic granules. *Anus* $\frac{1}{200}''$ from posterior extremity. *Ocelli* two highly refractive yellowish bodies, with a dark central spot on dorsal aspect at $\frac{1}{2000}''$ from anterior extremity. *Vulva* behind centre of body.

Male, length $\frac{1}{41}''$, breadth $\frac{1}{909}''$.

Œsophagus relatively shorter. *Anus* $\frac{1}{222}''$ from posterior extremity. *Spicules* barbed at upper extremity, curved, $\frac{1}{1000}''$ long; *accessory pieces* lying nearly at right angles to spicules, pointed.

Hab. Small green filamentous weed from tide-pools, Falmouth. Also observed in a small aquarium for two or three weeks, feeding on minute vegetable spores near the surface of water.

2. T. PARVUS, n. sp. (Plate XIII. figs. 185, 186.)

Female, length $\frac{1}{45}''$, breadth $\frac{1}{1250}''$.

External Characters.—Body tapering at both extremities, especially at posterior, commencing behind vulva. Head truncate, naked. Striæ of integument imperceptible.

Pharyngeal cavity indistinct. *Œsophagus* about $\frac{1}{7}$th of total length. *Intestine* sparingly covered with hepatic particles. *Anus* $\frac{1}{345}''$ from posterior extremity. *Vulva* posterior to middle of body. *Ocelli* . . . . . .

Male, not seen.

Hab. Small green weed from tide-pools, Falmouth.

23. THERISTUS[1], Bastian.

GEN. CHAR. Body tapering at extremities. *Caudal sucker* small; sucker-tubes not visible. *Integument* having transverse striæ; lateral, circular, convex prominences close to anterior extremity; cephalic setæ, but no papillæ. *Pharyngeal cavity* moderately large, rounded; parietes membranous, not horny. *Œsophagus* distinctly muscular, nearly cylindrical. *Intestine* plentifully covered with hepatic particles, more or less tessellate, and of a brownish colour. *Vulva* at commencement of posterior third of body. *Uterus* unsymmetrical. *Spicules* shaped like a reaper's hook. *Accessory pieces* two thin rounded plates directed backwards. *Ocelli* none. *Vaginal glands* two, unequal, pyriform. *Excretory ventral gland* . . . . *Lateral canals* . . . . Movements very active.

1. T. ACER, n. sp. (Plate XIII. figs. 187–188.)

Male, length $\frac{1}{15}''$, breadth $\frac{1}{434}''$.

External Characters.—Body tapering at extremities, slightly forwards, but gradually narrowing to a point posteriorly. Head rounded, furnished with about eight spreading setæ, arising from swollen bases. Integument having transverse striæ, $\frac{1}{12000}''$ apart; conical projections $\frac{1}{3333}''$ in diameter, at $\frac{1}{1250}''$ from anterior extremity.

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[1] *θεριστής, a reaper*, on account of the shape of the spicules.

Pharyngeal cavity rounded. *Œsophagus* between $\frac{1}{5}$th and $\frac{1}{6}$th of total length. *Intestine* abundantly covered with fat-particles having no distinct tessellate arrangement. *Anus* $\frac{1}{143}''$ from posterior extremity. *Spicules* $\frac{1}{666}''$ from point to point; *accessory pieces* curved backwards, and pyriform in shape.

Female, not seen.

Hab. Marine surface mud from estuary, Falmouth.

2. T. VELOX, n. sp. (Plate XIII. figs. 189–191.)

Female, length $\frac{1}{18}''$, breadth $\frac{1}{454}''$.

External Characters.—Body tapering slightly forwards, but rather abruptly behind vulva, and thence gradually to pointed posterior extremity. Head rounded, provided with 4–6 setæ, which are rather long, and directed forwards. Transverse striæ well marked, $\frac{1}{12000}''$ apart; convex lateral prominences of integument $\frac{1}{5000}''$ in diameter, at $\frac{1}{1000}''$ from anterior extremity.

Pharyngeal cavity rounded, $\frac{1}{2500}''$ deep. *Œsophagus* about $\frac{1}{5}$th of total length, nearly cylindrical. *Intestine* moderately well covered with olive-brown fat-particles, having a tessellate arrangement. *Anus* $\frac{1}{160}''$ from posterior extremity. *Vulva* at commencement of posterior third of body. *Vaginal glands* pyriform granular bodies, unequal, the posterior being much the larger and $\frac{1}{1250}''$ long.

Male, not seen.

Hab. About roots of small green sea-weed from tide-pools, Falmouth.

24. SPHÆROLAIMUS[1], Bastian.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* minute; sucker-tubes not visible. *Integument* having transverse and longitudinal markings; setæ abundant; cephalic papillæ absent. *Pharyngeal cavity* large and somewhat spherical, having peculiar sets of parietal linear markings. *Œsophagus* distinctly muscular, canal defined by three rather bright bands. *Intestine* rather densely covered with dark-coloured hepatic particles. *Vulva* considerably posterior to middle of body. *Uterus* unsymmetrical. *Spicules* long and narrow. *Accessory piece* single, posterior, somewhat shield-shaped. *Ocelli* none. *Vaginal gland* single, pyriform, posterior. *Excretory ventral gland* tubular, opening near middle of œsophagus. *Lateral canals* . . . .

Movements rapid, powerful.

S. HIRSUTUS, n. sp. (Plate XIII. figs. 192–194.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{133}''$.

External Characters.—Body thick in proportion to length, tapering slightly anteriorly, but more considerably towards posterior extremity, which is slightly swollen and rounded at termination; covered with rather long setæ, which are largest and most numerous about anterior extremity. Head rounded, somewhat conical. *Integument* having transverse striæ $\frac{1}{15000}''$ apart, and an appearance of longitudinal also, $\frac{1}{10000}''$ apart.

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[1] σφαιρα, *a globe*, and λαιμος, *the throat.*

Pharyngeal cavity somewhat globular, about $\frac{1}{400}''$ in depth, surrounded about middle by a dark band, apparently due to markings of its walls, whilst anteriorly more delicate lines are seen converging towards the mouth. *Œsophagus* about $\frac{1}{3}$rd of total length. *Intestine* densely covered with fat-particles of a dark colour, obscurely tessellate. *Anus* $\frac{1}{87}''$ from posterior extremity. *Vulva* considerably posterior to middle of body, $\frac{1}{100}''$ in front of anal cleft. *Vaginal gland* single, brownish, pyriform, projecting backwards, $\frac{1}{333}''$ long, by $\frac{1}{500}''$ wide. *Excretory ventral gland* tubular, not dilated at extremity, extending from posterior part to a little in front of middle of œsophagus, where its duct opens.

Male, length $\frac{1}{10}''$, breadth $\frac{1}{154}''$ *Œsophagus* shorter than in female. *Anus* $\frac{1}{91}''$ from posterior extremity. *Spicules* long, rather narrow, and moderately curved, $\frac{1}{115}''$ in length; *accessory piece* single, shield-shaped, with two grooves, along which the spicules glide, $\frac{1}{1000}''$ long, by $\frac{1}{1250}''$ broad.

Hab. Marine surface-mud from estuary, Falmouth.

25. COMESOMA[1], Bastian.

Gen. Char. *Body* tapering at extremities. *Caudal sucker* moderately distinct; sucker-tubes none (?). *Integument* having transverse and longitudinal striæ, spiral lateral cervical markings, setæ more or less abundant about anterior and posterior extremities, papillæ none. *Pharyngeal cavity* small, cup-shaped. *Œsophagus* muscular, more or less swollen posteriorly. *Intestine* moderately well covered with hepatic particles, mostly having a tessellate arrangement. *Vulva* about the middle of body. *Uterus* bifid; segments symmetrical. *Spicules* very long and narrow. *Accessory pieces* none, or, if present, single, small, and indistinct. *Ocelli* none. *Anal glands* (?). *Excretory ventral gland* consisting of a slightly dilated posterior portion and a wide duct extending from commencement of intestine to about middle of œsophagus. *Lateral canals* having a faintly granular appearance.

Movements moderately rapid, frequently forming body into a circular coil.

1. Comesoma vulgaris, n. sp. (Plate XIII. figs. 195–197.)

Female, length $\frac{1}{7}''$, breadth $\frac{1}{222}''$.

External Characters.—Body opaque white, tapering slightly towards head, but more considerably towards posterior extremity, which is long and narrow, but slightly swollen at termination. Head rounded, provided with two circlets of setæ, the anterior (four) being very long, but those forming the posterior, from six to eight in number, being much shorter. Other setæ scattered over anterior part of body. Integument with longitudinal markings $\frac{1}{7500}''$ apart, and more delicate transverse striæ $\frac{1}{15000}''$ apart; lateral spiral marking at same level as second circlet of setæ.

Pharyngeal cavity small, cup-shaped. *Œsophagus* $\frac{1}{11}$th of total length. *Intestine* covered with light-coloured hepatic particles, having a tessellate arrangement. *Anus* $\frac{1}{71}''$ from posterior extremity. *Vulva* at middle of body. *Excretory duct* opening opposite middle of œsophagus.

Male, same size as female. Posterior extremity having setæ scattered over its surface, especially in ventral region before and behind anus, where there is a linear series. *Anus* $\frac{1}{77}''$ from posterior extremity. *Spicules* very long and narrow, but slightly rounded and enlarged at points, length $\frac{1}{128}''$; *accessory piece* none.

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[1] *κόμη, hair*, and *σῶμα, body*.

Hab. Small green sea-weeds from tide-pools, Falmouth.

2. C. PROFUNDI, n. sp. (Plate XIII. figs. 198–200.)

Female, length $\frac{1}{9}''$, breadth $\frac{1}{250}''$.

External Characters.—Body light-coloured, slender, tapering gradually forwards, but more notably towards posterior extremity, which is rather long and filiform, having two small setæ at its termination. Head truncate, furnished with a circlet of six stout and long, spreading setæ. Integument having longitudinal markings, transverse not visible; two circular(?) depressions, one on each side of head, and about $\frac{1}{3333}''$ in diameter.

Pharyngeal cavity very small, almost wanting. *Œsophagus* about $\frac{1}{9}$th of total length, gradually widening towards termination. *Intestine* covered with pale-coloured hepatic particles, having a tessellate arrangement. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* about the middle of body. *Uterine segments* rather short. *Excretory duct* opening opposite middle of œsophagus.

Male, length $\frac{1}{9}''$, breadth $\frac{1}{333}''$.

Anus $\frac{1}{100}''$ from posterior extremity. *Spicules* very long, slightly curved, length $\frac{1}{143}''$, apparently not tubular, but grooved from angular bending. *Accessory piece* small, indistinct.

Hab. In mud dredged up from a depth of 20 fathoms, Falmouth Harbour.

26. SPIRA[1], Bastian.

GEN. CHAR. *Body* tapering at extremities. *Caudal sucker* very small and indistinct; sucker-tubes absent. *Integument* having transverse striæ; two small, lateral, circular, convex prominences or depressions of integument in cervical region; setæ not abundant, principally cephalic; cephalic papillæ wanting. *Pharyngeal cavity* wanting. *Œsophagus* short, distinctly muscular, with a simple terminal swelling. *Intestine* moderately well covered with rather large, light-coloured hepatic particles. *Vulva* at middle of body. *Uterus* bifid; segments symmetrical. *Spicules* curved, moderately broad, enlarged at upper extremities. *Accessory pieces* two, nearly straight. *Ocelli* none. *Excretory ventral gland* . . . . *Lateral canals* . . . .

Movements active.

1. S. PARASITIFERA, n. sp. (Plate XIII. figs. 201–203.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{333}''$.

External Characters.—Body opaque white, tapering anteriorly and also gradually to a point posteriorly. Head rounded, provided with a circlet of 4–6 short setæ. Integument with faint transverse striæ $\frac{1}{20000}''$ apart; small lateral hemispherical prominences close to anterior extremity.

Œsophagus about $\frac{1}{17}$th of total length; terminal swelling nearly globular. *Intestine* rather narrow, moderately well covered with rather large particles having a tessellate arrangement. *Anus* $\frac{1}{200}''$ from posterior extremity. *Vulva* near middle of body.

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[1] *σπεῖρα, a coil,* from the frequency with which they twist their bodies into this form.

Male, about same size as female. *Anus* about $\frac{1}{200}''$ from posterior extremity. *Spicules* rather short, curved, $\frac{1}{455}''$ in length; *accessory pieces* short, horizontal; proximal extremity curved and pointed.

Hab. Amongst sand and small stones from tide-pools, Falmouth.

Body often more or less covered with minute tufts of hair-like algæ, whilst to the posterior extremities of two specimens I have seen groups of *Vorticella* attached.

2. S. LÆVIS, n. sp. (Plate XIII. figs. 204–206.)

Female, length $\frac{1}{6}''$, breadth $\frac{1}{200}''$.

External Characters.—Body light-coloured, tapering slightly anteriorly, and gradually narrowing to a point posteriorly. Head most distinctly rounded. Integument smooth; no striæ visible; a few small setæ scattered over anterior extremity; lateral cervical depressions (slightly raised in centre) $\frac{1}{3333}''$ in diameter, close to anterior extremity.

Œsophagus between $\frac{1}{18}$th and $\frac{1}{19}$th of total length; terminal swelling nearly globular. *Intestine* sparingly covered with light-coloured hepatic particles having a somewhat tessellate arrangement. *Anus* $\frac{1}{166}''$ from posterior extremity. *Vulva* anterior to middle of body, $\frac{1}{15}''$ from anterior extremity. *Uterus* bifid; segments symmetrical. *Ova* large, occupying whole breadth of body. *Genital tube* containing large, spherical, finely granular cells, about $\frac{1}{1000}''$ in diameter.

Male, length $\frac{1}{7}''$, breadth $\frac{1}{285}''$.

Œsophagus about $\frac{1}{20}$th of total length. *Anus* $\frac{1}{181}''$ from posterior extremity. *Spicules* large, curved, $\frac{1}{333}''$ in length; *accessory pieces* straight, rather narrow, and half the length of spicules.

Hab. In sand from roots of small algæ, tide-pools, Falmouth.

3. S. TENUICAUDATA, n. sp. (Plate XIII. figs. 207–209.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{285}''$.

External Characters.—Body white, tapering gradually anteriorly, but more abruptly towards posterior extremity, which is long and filiform. Head truncate, provided with a circle of 4–6 setæ. Integument with transverse striæ, pretty well marked, $\frac{1}{20000}''$ apart; two lateral circular depressions close to anterior extremity, $\frac{1}{3333}''$ in diameter; when looked down upon, a small central circle is seen $\frac{2}{3}$rds less in diameter than that which contains it.

Œsophagus about $\frac{1}{9}$th of total length; posterior enlargement not nearly globular. *Intestine* covered pretty uniformly with pale small-sized granules. *Anus* $\frac{1}{133}''$ from posterior extremity. *Vulva* about middle of body.

Male, length $\frac{1}{12}''$, breadth $\frac{1}{335}''$; having a few short setæ scattered over posterior extremity. *Anus* $\frac{1}{154}''$ from posterior extremity. *Spicules* narrow, curved, $\frac{1}{500}''$ long; *accessory pieces* reflexed, curved, almost linear, $\frac{1}{668}''$ long.

Hab. In sand from tide-pools, Falmouth.

The different shape and length of the œsophagus, as well as the difference in form of the spicules and accessory pieces, lead me to suspect that this species will hereafter require to be transferred to a distinct though nearly allied genus. Its present position may be looked upon merely as provisional.

27. ODONTOBIUS, Roussel.

GEN. CHAR. "*Body* thread-like; anterior extremity more or less narrowed; posterior obtusely or sharply pointed, ending in a small papilla. Around the mouth and on anterior part of body are several cirri. On the hinder part of the body of the male, around the genital opening, are one or two rows of roundish integumental prominences.

"*Skin* colourless or of a yellowish-green colour, occasionally iridescent. External integument smooth or transversely striped. Œsophagus cylindrical, widening slightly posteriorly; external layer or sheath composed of a finely granular mass, or cylindrical cells.

"*Vagina* variable in position. Lateral lines present. Gland (ventral?) of anterior part of body doubtful. Tail-glands consisting of an agglomeration of cells.

"Two spicules, with an anterior accessory organ[1], or two pairs of spicules, one large and one small."—*Eberth*, Unters. über Nemat. p. 27.

This description is the one given by Eberth, which I have inserted rather than that of Roussel, from its containing more details, though even these are insufficient accurately to characterize and fix the position of the genus. Eberth naturally enough objects to Diesing's having in his recent "Revision der Nematoden" placed this genus amongst his subfamily *Anguillulidæ*, since Roussel's *Odontobius* was distinctly stated to be provided with cirri around the mouth. Eberth is, however, himself uncertain what systematic place to assign to this genus, but says that he includes in it several free Nematoids which, from the appearance of small teeth[2] in the mouth, are distinguished from those of *Amblyura*, *Phanoglene*, *Enchelidium*, and *Oncholaimus*, and, through the want of ocelli, from those of *Enoplus*.

Whether the original animal described by Roussel de Vauzème, and found by him in or on the mucous membrane about the base of the whalebone in *Balæna Australis*, is rightly included amongst the free Nematodes is a point about which I am still doubtful; but, as it seems quite possible that one of these animals might be met with in such a situation, I have retained it amongst them, and have refrained from altering the designation of three of the species placed by Eberth in this genus, though one of them seems to differ in some important respects from the other two.

1. O. CETI, Roussel.

Odontobius Ceti, Roussel de Vauzème, in Annal. des Sc. Nat. 2 sér. i. 326, tab. ix. 1–5 A; et Froriep's Notiz. xxxvii. 1, figs. 3–6; Isis, 1836, p. 512.—Siebold, in Wiegmann's Archiv, 1835, i. 336.—Nordmann, in Lamarck's Anim. sans Vert. 2de édit. iii. 669.—Dujardin, Hist. Nat. des Helminthes, 292.

"*Corpus* capillare, extremitate caudali involuta. *Caput* corpore continuum. *Os* terminale, orbiculare, dentibus corneis 3–6. *Penis* . . . .; apertura genitalis feminea . . . . . Longit. ad $2\frac{1}{2}'''$.

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[1] This seems only to have been met with in *Odontobius acuminatus*, which I have transferred to the genus *Anticoma*, so that the latter part of this sentence only must now be considered as applicable to the genus *Odontobius*.

[2] He omits to mention these in his generic description given above.

"*Hab. Balæna australis*, in strato mucoso elasmatis cum ovulis suis gregarie nidulans; ad insulas Malorinas, Octobri usque ad Januarium."—*Diesing*, Syst. Helm. vol. ii. p. 123.

2. O. MICANS, Eberth.

Unters. über Nemat. p. 28, tab. i. figs. 1–5.

"*Körper* des Weibchens fadenförmig, Kopf wenig verschmälert, quer abgestutzt, von einem Haarkranze umgeben, vom übrigen Körper durch eine seichte Einschnürung getrennt. Schwanz gegen den Bauch eingekrümmt, in eine kurze Spitze endigend. Hinterende des Männchens stärker eingebogen.

"Weibchen 1·5 Mm. lang, 0·15 Mm. breit.

"Männchen 1·25 Mm. lang, 0·13 Mm. breit.

"Oesophagus=ein Viertel der Körperlänge."

3. O. FILIFORMIS, Eberth.

Unters. über Nemat. p. 29, tab. i. figs. 10–12.

"*Körper* des Männchens fadenförmig, von leicht gelblicher Färbung, schon vom Oesophagus an ziemlich stark einwärts gerollt. *Kopf* fast quer abgestutzt, hinter dem Pharynx leicht eingeschnürt. In der Gegend des letzteren etwas weiter nach hinten ist die Haut mit feinen kurzen Härchen besetzt, welche in Querreihen angeordnet scheinen. Das Schwanzende des Männchens wenig verjüngt und stumpf geendigt.

"*Länge* des Männchens 7 Mm., Breite 0·08 Mm.

"Oesophagus=ein Sechstel der Körperlänge."

4. O. STRIATUS, Eberth.

Unters. über Nemat. p. 30, tab. i. figs. 21–27.

"*Körper* bei beiden Geschlechtern ziemlich gleich, fadenförmig, gegen den Bauch eingekrümmt, in der Mitte stärker anschwellend, an beiden Enden verschmälert. Vorderende fast quer abgestutzt, um die Mundöffnung und hinter dieser mit kurzen Härchen besetzt. Schwanzende abgerundet, mit einer spitzen durchborten Papille versehen.

"*Länge* des Weibchens 3 Mm., Breite 0·175 Mm.

"Länge des Männchens 2 Mm., Breite 0·1 Mm.

"Oesophaguslänge $\frac{3}{4}$ Mm."

28. CYATHOLAIMUS[1], Bastian.

GEN. CHAR. *Body* mostly of a brownish colour, tapering at extremities; posterior conical. *Caudal sucker* mostly well marked, cylindrical; sucker-tubes occasionally present. *Integument* having transverse striæ or rows of dots; small, lateral, circular, convex prominences in cervical region, and occasionally others over posterior part of body; cephalic setæ generally present, papillæ occasionally. *Pharyngeal cavity* cup-shaped, with slight longitudinal rib-like markings. *Œsophagus* nearly uniform and cylindrical; central canal broad. *Intestine* moderately well covered with large and

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[1] κύαθος *a cup*, and λαιμός, *the throat*, in allusion to the shape of the pharyngeal cavity.

generally dark fawn-coloured hepatic particles. *Vulva* about the middle of body. *Uterus* bifid; segments symmetrical. *Spicules* rather thick and solid, of a yellowish colour. *Accessory pieces* four, in two pairs, the longer being somewhat lamelliform, whilst the external pair are thick and quadrilateral. *Ocelli*, two aggregations of brownish pigment on dorsum of œsophagus; not present in some species. *Glandular system* well developed; subcutaneous, glandular, cell-like bodies numerous; anal glands three, occasional. *Excretory ventral gland* terminating in moderate-sized duct, opening opposite middle of œsophagus. *Lateral canals* . . . .

Movements moderately active.

* *Caudal sucker well marked, cylindrical.*

1. C. OCELLATUS, n. sp. (Plate XIII. figs. 210–212*a*.)

Female, length $\frac{1}{17}''$, breadth $\frac{1}{460}''$.

External Characters.—Body tapering slightly forwards, but much more towards posterior extremity. Head rounded, provided with a circlet of four small setæ. Integument with delicate transverse striæ, faintly visible, $\frac{1}{20000}''$ apart; shreds easily peeling off under pressure.

Pharyngeal cavity $\frac{1}{2500}''$ deep. *Œsophagus* rather less than $\frac{1}{7}$th of total length. *Intestine* thinly covered with fat-particles, non-tessellated. *Anus* $\frac{1}{215}''$ from posterior extremity. *Vulva* slightly anterior to middle of body. *Ocelli*, two small greenish-brown masses of pigment, $\frac{1}{900}''$ from anterior extremity. *Subcutaneous gland-cells* numerous, rounded, granular, giving the animal a peculiar maculated appearance.

Male, length $\frac{1}{22}''$ breadth $\frac{1}{535}''$.

Anus $\frac{1}{328}''$ from posterior extremity. *Spicules* curved, somewhat wedge-shaped, $\frac{1}{500}''$ long; *accessory pieces* four; principal pair rather long, narrow, and united in middle line; external pair rounded.

Hab. About *Cladophora rupestris* from tide-pools, Falmouth.

2. C. CÆCUS, n. sp. (Plate XIII. figs. 213, 214.)

Female, length $\frac{1}{15}''$, breadth $\frac{1}{333}''$.

External Characters.—Body tapering slightly forwards, but gradually narrowing to a point posteriorly. Head broad, truncate, having a circlet of four small setæ. Integument with almost imperceptible transverse striæ, about $\frac{1}{30000}''$ apart.

Pharyngeal cavity cup-shaped. *Œsophagus* about $\frac{1}{7}$th of total length. *Intestine* sparsely covered with large, coloured hepatic particles. *Anus* $\frac{1}{238}''$ from posterior extremity. *Vulva* anterior to middle of body. *Ocelli* wanting. *Subcutaneous gland-cells* round or oval, granular, about $\frac{1}{2000}''$ in diameter.

Male, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

3. C. ORNATUS, n. sp. (Plate XIII. figs. 215, 216.)

Female, length $\frac{1}{27}''$, breadth $\frac{1}{357}''$.

External Characters.—Body stout, light fawn-coloured, tapering slightly forwards, but gradually to a point posteriorly, where it terminates in an elongated sucker; sucker-tubes two, short, distinct. Head truncate, provided with 8–10 short setæ directed forwards. Integument with transverse striæ scarcely perceptible, $\frac{1}{20000}''$ apart.

Pharyngeal cavity cup-shaped, $\frac{1}{2000}''$ deep. *Œsophagus* rather less than $\frac{1}{4}$th of total length. *Intestine* well covered with brownish fat-particles having a tessellate arrangement. *Anus* $\frac{1}{250}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Ocelli*, two aggregations of brown pigment, at $\frac{1}{1000}''$ from anterior extremity. *Subcutaneous gland-cells* abundant. *Anal glands* three, large. *Excretory ventral gland* opening opposite middle of œsophagus; duct rather narrow, uniform in size.

Male, not seen.

Hab. Small green sea-weed from tide-pool, Falmouth[1].

** *Caudal sucker small, indistinct.*

4. C. PUNCTATUS, n. sp. (Plate XIII. figs. 217, 218.)

Male, length $\frac{1}{12}''$, breadth $\frac{1}{263}''$.

External Characters.—Body powerful, tapering very slightly anteriorly, but gradually to a point posteriorly. Head obtusely rounded, provided with a circlet of 6–8 small spreading setæ; other small setæ scattered over posterior part of body. Integument having rows of dots arranged in transverse series $\frac{1}{15000}''$ apart; two lateral convex prominences of integument in cervical region nearly opposite base of pharyngeal cavity, $\frac{1}{3333}''$ in diameter.

Pharyngeal cavity cup-shaped. *Œsophagus* about $\frac{1}{10}$th of total length. *Intestine* sparsely and irregularly covered with large brownish-coloured fat-particles. *Anus* $\frac{1}{117}''$ from posterior extremity. *Spicules* $\frac{1}{333}''$ long. *Ocelli* two, greenish brown, large, $\frac{1}{1428}''$ from anterior extremity. *Subcutaneous gland-cells* wanting.

Female, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

5. C. STRIATUS, n. sp. (Plate XIII. figs. 219, 220.)

Male, length $\frac{1}{12}''$, breadth $\frac{1}{285}''$.

External Characters.—Body tapering slightly anteriorly, but gradually to a point posteriorly. Head obtusely rounded, provided with two small papillæ, upper and lower, and a circlet of about six setæ directed forwards. Integument with very distinct transverse striæ $\frac{1}{12000}''$ apart; a few scattered setæ over anterior part of body, but numerous others posteriorly behind anal cleft.

Pharyngeal cavity cup-shaped, $\frac{1}{2000}''$ deep. *Œsophagus* $\frac{1}{11}$th of total length. *Intestine* well covered with hepatic particles having a tessellate arrangement. *Anus* $\frac{1}{125}''$ from posterior extremity. *Spicules* thick, strong, slightly curved, $\frac{1}{400}''$ long: *accessory pieces* four; two median lanceolate, thin; two external stout, quadrilateral. *Ocelli* wanting. *Subcutaneous gland-cells* plentiful.

Female, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

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[1] Or else from marine surface-mud of estuary. I am not quite certain which, as the habitat was unfortunately not entered at the time when the species was discovered and described.

6. C. GRACILIS.

Enoplus gracilis, Eberth, Unters. über Nemat. p. 34, tab. ii. figs. 13–19.

"*Körper* in der Mitte leicht angeschwollen, Vorderende verschmälert, Kopf abgerundet, leicht vom übrigen Körper abgeschnürt. Hinterende beider Geschlechter zugespitzt und gegen den Bauch eingebogen. Der Schwanz in einen kleinen durchbohrten zierlichen Fortsatz ausgezogen . . . . . .

"Länge des Weibchens $3\frac{1}{4}$ Mm., Breite 0·15 Mm.

"Länge des Männchens 2 Mm., Breite 0·1 Mm.

"Oesophaguslänge verhält sich zur Körperlänge wie 1 : 6."

I have placed this animal in the genus *Cyatholaimus*, because it seems more nearly allied to the representatives of this type than to any others that I have met with. It is most certainly not an *Enoplus*, and will hereafter, I suspect, be found to belong to a genus distinct from, though closely allied to, the one in which I have now temporarily located it.

29. SPILIPHERA[1], Bastian.

GEN. CHAR. *Body* tapering at extremities, conical posteriorly. *Caudal sucker* elongated, cylindrical; sucker-tubes undeveloped. *Integument* having transverse rows of dots or striæ, and two longitudinal rows of dots close together in each lateral region, as well as a spiral cervical marking on each side, close to the head; cephalic setæ mostly present; no papillæ. *Pharyngeal cavity* cup-shaped, having longitudinal rays or rib-like markings and three horny apophyses spreading from its base. *Œsophagus* frequently enlarged behind pharynx, and generally terminating in an ovoid swelling. *Intestine* mostly pretty well covered with large, coloured hepatic particles. *Vulva* about middle of body. *Uterus* bifid; segments symmetrical. *Spicules* curved, narrow. *Accessory pieces* two, somewhat ovate, indistinct. *Ocelli* absent. *Anal glands* three, sometimes absent. *Excretory ventral gland* opening near middle of œsophagus. *Lateral canals* . . . . . .

Movements moderately active.

1. S. ELEGANS, n. sp. (Plate XIII. figs. 221, 222.)

Male, length $\frac{1}{17}''$, breadth $\frac{1}{250}''$.

External Characters.—Body tapering most at posterior extremity. Head bluntly rounded, provided with 2–4 minute setæ, directed forwards. Integument having transverse rows ($\frac{1}{7500}''$ apart) of minute rectangular dots, and two longitudinal rows of larger ones, $\frac{1}{5000}''$ apart, on each side of body.

Pharyngeal cavity somewhat infundibuliform, $\frac{1}{2000}''$ deep; three curved equal-sized apophyses extending backwards into substance of œsophagus, $\frac{1}{1428}''$ in length. *Œsophagus* $\frac{1}{6}$th of total length; swollen opposite apophyses, and again very distinctly at termination. *Intestine* covered irregularly with large-sized, greenish-yellow hepatic particles. *Anus* $\frac{1}{200}''$ from posterior extremity. *Spicules* narrow, slightly curved, $\frac{1}{454}''$

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[1] σπῖλος, *a spot*, and φέρω, *to bear*, in reference to the integumental markings.

long; *accessory pieces* ovate, leaf-like, about $\frac{1}{3}$rd as long, rather indistinct. *Anal glands* . . . . . . *Excretory ventral duct* . . . . . .

Female, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

2. S. INÆQUALIS, n. sp. (Plate XIII. figs. 223–225.)

Female, length $\frac{1}{28}''$, breadth $\frac{1}{500}''$.

External Characters.—Body tapering as in last species. Head slightly rounded, provided with 2–4 spreading setæ. Integument with well-marked transverse striæ, $\frac{1}{15000}''$ apart, and two longitudinal lines of dots, about $\frac{1}{5000}''$ apart, on each side of the body.

Pharyngeal cavity cup-shaped, rather indistinct, having two apophyses extending backwards for about $\frac{1}{1666}''$, the third being small and abortive. *Œsophagus* $\frac{1}{5}$th of total length, with post-pharyngeal and terminal swellings. *Intestine* covered pretty uniformly with large olive-yellow-coloured fat-particles. *Anus* $\frac{1}{200}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Excretory ventral duct* . . . . . .

Male, about same size or rather larger.

Anus $\frac{1}{222}''$ from posterior extremity. *Spicules* narrow, slightly curved, $\frac{1}{1000}''$ long; *accessory pieces* indistinct. In *mid-ventral region*, anterior to anal cleft, is a linear series of about fifteen small, bright, rectangular spots, equidistant and $\frac{1}{2000}''$ apart.

Hab. Marine surface-mud of estuary, Falmouth.

3. S. ROBUSTA, n. sp. (Plate XIII. figs. 226, 227.)

Female, length $\frac{1}{12}''$, breadth $\frac{1}{222}''$.

External Characters.—Body stout, of a brownish-yellow colour, scarcely tapering at all anteriorly, but very abruptly posterior to anus. Head rounded, naked. Integument with rows of dots, transverse, and $\frac{1}{12000}''$ apart.

Pharyngeal cavity large, $\frac{1}{1000}''$ deep, longitudinal ribs well marked; three very thick and nearly straight apophyses extending backwards for $\frac{1}{1000}''$. *Œsophagus* $\frac{1}{6}$th of total length, cylindrical, and nearly uniform in size. *Intestine* covered with large, yellowish granules having a tessellate arrangement. *Anus* $\frac{1}{222}''$ from posterior extremity. *Vulva* slightly anterior to middle of body. *Uterus* bifid. *Excretory ventral gland* extending from about middle of œsophagus to commencement of intestine. *Anal glands* three, large, occupying nearly the whole of space posterior to anal cleft.

Male, not seen.

Hab. Marine surface-mud of estuary, Falmouth.

The very large size of the apophyses, the uniform calibre of the œsophagus, and the apparent absence of the lateral longitudinal rows of dots are all divergences from the typical characters of this genus, whose value it is at present difficult to estimate, and more particularly so since the characters of the male are as yet unknown.

4. S. COSTATA, n. sp. (Plate XIII. figs. 228, 229.)

Male, length $\frac{1}{19}''$, breadth $\frac{1}{435}''$.

External Characters.—Body rather dark in colour anteriorly; tapering conically at posterior extremity. Sucker cylindrical, well marked. Head truncate, having a circlet of four strong patent setæ. Integument with most marked transverse striæ, $\frac{1}{10000}''$ apart, and equidistant longitudinal ridges, very obvious in the middle portions of body, but less evident towards extremities.

Pharyngeal cavity indistinct. *Œsophagus* about $\frac{1}{7}$th of total length, with post-pharyngeal and terminal swellings. *Intestine* undistinguishable, from the total absence of the usual hepatic cells and contained fat-particles. *Anus* $\frac{1}{200}''$ from posterior extremity. *Spicules* slightly curved and rather broad, $\frac{1}{166}''$ long; *accessory pieces* not recognized.

Female, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

Having only seen two specimens of this species, I am not quite certain about the exact structure of its pharynx, and the presence or absence of accessory pieces to the spicules. The almost uniform light colour of, and absence of pigment from its internal parts, combined with a somewhat opaque integument, was the cause of my failure in ascertaining these points.

30. CHROMADORA[1], Bastian.

Rhabditis, Max Schultze; *Enoplus*, Diesing.

GEN. CHAR. *Body* tapering at extremities; conical posteriorly. *Caudal sucker* elongated, pointed; sucker-tubes not developed. *Integument* having transverse and longitudinal striæ, frequently somewhat clouded and opaque anteriorly; cephalic setæ generally present, papillæ not. *Pharyngeal cavity* small and indistinct, with three cuneiform horny apophyses (apices downwards) extending backwards, and in contact. *Œsophagus* having a more or less distinct swelling posteriorly; muscular tissue not well developed. *Intestine* mostly covered with irregularly arranged, large-sized, coloured hepatic particles. *Vulva* at middle of body. *Uterus* bifid; segments symmetrical. *Spicules* two, somewhat narrow, curved. *Accessory pieces* well marked, about half as long as spicules. *Ocelli* two masses of reddish pigment on dorsum of anterior part of œsophagus; sometimes wanting. *Glandular system* not much developed. *Excretory ventral gland* opening by a rather small duct nearly opposite middle of œsophagus (?). *Lateral canals* . . . . . .

Movements active.

1. C. VULGARIS, n. sp. (Plate XIII. figs. 233–235.)

Female, length $\frac{1}{10}''$, breadth $\frac{1}{250}''$.

External Characters.—Body clouded anteriorly, tapering from near the middle to either extremity, but somewhat widening again at head, which is truncated and provided with small setæ. Integument with very distinct transverse striæ at intervals of $\frac{1}{5000}''$, which are crossed by delicate longitudinal lines $\frac{1}{30000}''$ apart; small longitudinal ridge on either side of body[2].

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[1] χρῶμα, *pigment*, and δορὰ, *skin*, on account of the frequency with which the transparency of the integument of the anterior part of the body is obscured by a dark tinge of colour.

[2] About anterior part of body the markings of integument seem almost more dotted than linear.

Pharyngeal cavity shallow and indistinct; apophyses well marked, $\frac{1}{1000}''$ long. *Œsophagus* about $\frac{1}{7}$th of total length, with a large ovoid swelling at termination, and provided with two rows of brownish pigment extending backwards on either side from two local reddish-brown aggregations $\frac{1}{666}''$ from the anterior extremity and within the sheath of œsophagus. *Intestine* covered with fat-particles, having a more or less tessellate arrangement. *Anus* $\frac{1}{100}''$ from posterior extremity. *Vulva* at middle of body. *Ocelli* as above.

Male, length $\frac{1}{13}''$, breadth $\frac{1}{285}''$.

Anus $\frac{1}{133}''$ from posterior exterior extremity. *Spicules* curved, $\frac{1}{333}''$ long; *accessory pieces* two, strong, broad, $\frac{1}{588}''$ long.

Hab. Very abundant about *Cladophora rupestris* and some other small green weeds from tide-pools, Falmouth.

2. C. NUDICAPITATA, n. sp. (Plate XIII. figs. 230–232.)

Female, length $\frac{1}{33}''$, breadth $\frac{1}{666}''$.

External Characters.—Body tapering very slightly forwards. Head rounded, naked. Integument with delicate transverse striæ, $\frac{1}{15000}''$ apart; longitudinal not recognized.

Pharyngeal cavity shallow and indistinct; apophyses $\frac{1}{2500}''$ long. *Œsophagus* about $\frac{1}{7}$th of total length; rounded swelling at termination. *Intestine* sparingly covered with hepatic particles. *Anus* $\frac{1}{220}''$ from posterior extremity. *Vulva* slightly anterior to middle of body. *Ocelli* two, reddish brown, at $\frac{1}{1000}''$ from anterior extremity; occasionally one only, in middle line.

Male, length $\frac{1}{33}''$, breadth $\frac{1}{835}''$.

Anus $\frac{1}{330}''$ from posterior extremity. *Spicules* slightly curved, $\frac{1}{833}''$ long; *accessory pieces* narrow, and curved at inner extremities, about $\frac{1}{1200}''$ long. In *mid-ventral* region above anus, within the substance of the integument, are five disk-shaped, highly refractive bodies, about $\frac{1}{5000}''$ in diameter, whose distances apart gradually diminish anteriorly.

Hab. On small, stunted, greyish specimens of *Cladophora rupestris* from tide-pools near high-water mark, Falmouth.

3. C. NATANS, n. sp. (Plate XIII. figs 236–238.)

Female, length $\frac{1}{22}''$, breadth $\frac{1}{500}''$.

External Characters.—Body tapering very slightly towards anterior extremity, but as usual at posterior. Head rounded, provided with four spreading setæ. Integument very transparent, not darkened anteriorly, having transverse striæ $\frac{1}{12000}''$ apart; longitudinal not recognized.

Pharyngeal cavity indistinct; apophyses $\frac{1}{1666}''$ in length. *Œsophagus* $\frac{1}{7}$th of total length. *Intestine* well covered with large-sized greenish-yellow granules, having no distinct arrangement. *Anus* $\frac{1}{182}''$ from posterior extremity. *Vulva* at middle of body. *Ocelli* two distinct conical aggregations of red pigment, situated almost laterally on the œsophagus, which is somewhat narrower at this point.

Male, length $\frac{1}{23}''$, breadth $\frac{1}{555}''$.

Anus $\frac{1}{211}''$ from posterior extremity. *Spicules* rather narrow, curved, $\frac{1}{714}''$ long;

accessory pieces $\frac{1}{909}''$ long. In *mid-ventral* region, above anus, is a linear series of five highly refractile roundish bodies, similar in kind to those of *C. nudicapitata.*

Hab. Found swimming near the surface of the water in a small aquarium containing weeds from tide-pools, Falmouth.

4. C. CÆCA, n. sp. (Plate XIII. figs. 239–241.)

Female, length $\frac{1}{30}''$, breadth $\frac{1}{500}''$.

External Characters.—Body tapering considerably at both extremities. Head truncate, provided with four setæ directed forwards. Integument having well-marked transverse striæ at $\frac{1}{20000}''$ apart, and with the appearance of longitudinal also.

Pharyngeal cavity small, indistinct; apophyses three. *Œsophagus* about $\frac{1}{7}$th of total length; posterior swelling distinct. *Intestine* sparsely and irregularly covered with fat-granules of large size. *Anus* $\frac{1}{238}''$ from posterior extremity. *Vulva* about the middle of body. *Ocelli* wanting.

Male, length $\frac{1}{37}''$, breadth $\frac{1}{500}''$.

Anus $\frac{1}{285}''$ from posterior extremity. *Spicules* slender, curved, $\frac{1}{1000}''$ long; *accessory pieces* two, nearly half as long.

Hab. Marine surface-mud from estuary, Falmouth.

5. C. FILIFORMIS, n. sp. (Plate XIII. figs. 242–244.)

Female, length $\frac{1}{30}''$, breadth $\frac{1}{666}''$.

External Characters.—Body very slender, tapering most notably towards extremities, so as to appear somewhat spindle-shaped. Head bluntly rounded, provided with 2–4 setæ. Integument with transverse striæ $\frac{1}{15000}''$ apart.

Pharyngeal cavity indistinct; length of apophyses $\frac{1}{2000}''$. *Œsophagus* about $\frac{1}{6}$th of total length; posterior swelling not very distinct. *Intestine* thinly covered with irregularly disposed hepatic particles. *Anus* $\frac{1}{222}''$ from posterior extremity. *Vulva* slightly posterior to middle of body. *Ocelli* two, reddish brown, $\frac{1}{1250}''$ from anterior extremity.

Male, longer, though more slender, than female; length $\frac{1}{22}''$, breadth $\frac{1}{1000}''$.

Anus $\frac{1}{182}''$ from posterior extremity. *Spicules* rather short, curved, $\frac{1}{1250}''$ in length. *Accessory pieces* about half as long.

Hab. Small green sea-weeds from tide-pools, Falmouth.

6. C. SABELLOIDES, n. sp. (Plate XIII. figs. 245, 246.)

Male, length $\frac{1}{31}''$, breadth $\frac{1}{666}''$.

External Characters.—Body tapering very slightly anteriorly, but in usual manner at posterior extremity. Head rounded, provided with four moderately long setæ. Integument with transverse striæ $\frac{1}{15000}''$ apart; longitudinal not recognizable.

Pharyngeal cavity indistinct; apophyses about $\frac{1}{3333}''$ in length. *Œsophagus* about $\frac{1}{5}$th of total length; posterior third forming an elongated terminal swelling. *Intestine* thinly covered with hepatic granules. *Anus* $\frac{1}{285}''$ from posterior extremity. *Spicules* slightly curved, $\frac{1}{1000}''$ long. *Accessory pieces* $\frac{1}{1666}''$ long.

Female, not seen.

Hab. Marine surface-mud, Falmouth. Found in the mud, moving about with a tube like that of a *Sabella*, composed of the finest particles of sand and *Diatomaceæ* agglutinated together. Tube longer than worm, but embracing its body pretty closely.

7. C. PAPILLATA, n. sp. (Plate XIII. figs. 247, 248.)

Male, length $\frac{1}{15}''$, breadth $\frac{1}{333}''$.

External Characters.—Body tapering slightly anteriorly; posterior extremity rather narrower, and more elongated than usual. Head rounded, provided with two (upper and lower) horn-like papillæ in front, and four rounded ones (crucially arranged) behind them; also four setæ arising close to these posterior papillæ. Integument brittle, clouded anteriorly, having well-marked transverse striæ $\frac{1}{7000}''$ apart, and longitudinal ones at a distance of $\frac{1}{30000}''$.

Pharyngeal cavity and apophyses . . . . . . *Œsophagus* $\frac{1}{6}$th of total length, slightly swollen posteriorly. *Intestine* moderately well covered with light-coloured hepatic particles. *Anus* $\frac{1}{133}''$ from posterior extremity; posterior boundary of anal cleft rather prominent, and containing a small horny body within its substance. *Spicules* curved, rather narrower at upper extremities, $\frac{1}{357}''$ long; *accessory pieces* strong, hook-like, $\frac{1}{625}''$ long. *Ocelli* wanting. *Excretory ventral duct* rather narrow; opening opposite middle of œsophagus.

Female, not seen.

Hab. Marine surface-mud from estuary, Falmouth.

The nature of the head and pharynx in this species differs somewhat from the strict type of this genus, though, in other important points, the characters are identical.

8. C. BIOCULATA.

Rhabditis bioculata, M. Schultze.—V. Carus's Icones Zootom. tab. viii. 2.

Enoplus bidentatus, Diesing, Sitzungs. der Kais. Akad. der Wissen. xlii. Band (1860), p. 625.

No description.

9. C. OCELLATA.

Urolabes ocellata, Carter, Ann. of Nat. Hist. ser. 3. vol. iv. p. 43.

Phanoglene ocellata, Eberth, Unters. über Nemat. p. 21, pl. iii. fig. 31.

"*Female*, linear, cylindrical, unstriated [1], ocellated, diminishing gradually towards the head, which is obtuse and provided with four short, linear cirri; also diminishing gradually towards the tail, which is short, somewhat curved, and furnished with a pointed digital termination. Mouth, vulva [2], and anus situated as in the foregoing species.

"Alimentary canal the same, but with the œsophageal sheaths more bulbous posteriorly, and no globular dilatation of the intestinal sheath posterior to it."

"*Size.* About $\frac{1}{32}$nd of an inch long."

"*Male*, the same as the female, with the exception of the difference in the generative organs."

"*Hab.* Silty clots of *Oscillatoria* floating in the salt-water main drain of the town of Bombay."

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[1] Perhaps striæ fine, and not recognized.

[2] In middle of body.

GENERA IMPERFECTLY DESCRIBED.

31. AMBLYURA, Hemprich and Ehrenberg.

Enchelis, Hill; *Vibrio*, Müller; *Enoplus*?, Dujardin; *Anguillula*, Leidy.

GEN. CHAR. "*Corpus* capillare, extremitate caudali subulata, papilla suctoria subclavatum. *Caput* corpore continuum, truncatum. *Os* terminale, orbiculare, cirrhatum. *Ocelli* nulli. *Penis* simplex, nec vaginatus; apertura genitalis feminea . . . . . . Aquarum dulcium et maris incola; natatoria."

1. A. SERPENTULUS, Hemprich and Ehrenberg.

Spalanzani, Microsc. 189, figs. 2 et 12.—Fränkische Samml. iv. 227, figs. *b–f*.

Enchelis, Hill, Hist. Anim. tab. i. (ic. mediocris).

Vibrio serpentulus, Müller, Verm. Terr. et Fluv. 24.—Ejus Zool. Dan. Prodr. 2449, et ejus Anim. Infus. 61, tab. viii. 15.—Bory, in Encyl. Méth. 1824, 777, tab. iv. 10.—Blainville, in Dict. des Sc. Nat. lvii. 537, et lviii. 69.

Amblyura Serpentulus, Hemprich et Ehrenberg, Symb. Phys. Phytoz. Entoz. tab. ii. 14 (omissis cirrhis). —Ehrenberg, Infusionsth. 82.—Lamarck, Anim. sans Vert. 2nde édit. iii. 663.—Dujardin, Hist. Nat. des Helminthes, 237.

Anguillula longicauda, Leidy, in Proc. Acad. Philad. v. (1851) 225.

Amblyura serpentulus?, Leidy, ibid. viii. (1854) 49.

"*Cauda* elongata, clavata. Longit. $\frac{1}{8}'''$."

"*Hab.* In infusione vegetabili plurium septimanarum et in palustribus, in Dania raro (*Müller*). In montibus Sinaiticis cum Confervis e rivulo vallis Wadi Esle prope Tor, et Berolini (*Ehrenberg*). Inter fila *Lyngbyæ muralis* aliarumque Confervarum in aquæductu, Philadelphiæ (*Leidy*[1])."

Nota. "De *Amblyura Serpentulo* Berolinensi præterea sequentia valent:—Corpus subtilissime, transverse striolatum, subannulatum. Tubus cibarius hinc ore, illinc ano terminatus simplex, strictura cardiaca insignis. Os terminale, anus ad caudæ basin lateralis. Feminarum apertura genitalis in medio corpore. Uterus bicornis. Feminæ maribus majores."—*Hemprich* et *Ehrenberg*.

2. A. GORDIUS, Hemprich et Ehrenberg.

Vibrio Gordius, Müller, Anim. Infus. 60, tab. viii. 13, 14.

Amblyura Gordius, Hemprich et Ehrenberg, Symb. Phys. Phytoz. Entoz.—Ehrenberg, Insfusionsth. 82.—Lamarck, Anim. sans Vert. 2nde édit. iii. 663.—Dujardin, Hist. Nat. des Helminthes, 238.

Enoplus elongatus, Dujardin?, Hist. Nat. des Helminthes, 238.

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[1] Dr. Leidy's description, collected from the two notices, is as follows:—

"*Amblyura serpentulus.*—Body cylindrical, colourless, hyaline; anteriorly obtusely rounded; posteriorly attenuated, with a long, delicate, flexible, subulate tail; suctorial disk exceedingly minute, clavate. Mouth with cirri; œsophagus cylindrical, often with the appearance of a globular bulb at its lower end; intestines cylindrical. Anus indistinct. Generative apparatus?

"Length of largest $\frac{1}{40}''$; breadth $\frac{1}{1000}''$; length of tail $\frac{1}{2000}''$. Smallest, length $\frac{1}{160}''$; breadth $\frac{1}{2000}''$; length of tail $\frac{1}{800}''$. In an individual $\frac{1}{100}''$ long, the œosophagus measured $\frac{1}{5700}''$ long.

"*Hab.* Found under *Lyngbya muralis* and other Confervæ about gutters and water-spouts in the City of Philadelphia. This species is very active in its movements, and appears to have the power of fixing itself by the end of the tail to surrounding objects."

"*Cauda* brevis, globifera. Longit. . . . . . ."

"*Hab.* In infuso marino (*O. F. Müller, Ehrenberg*)."

3. A. MUCRONATA, Diesing[1].

Czernay, in Bullet. de Moscou, xxvi. (1853) 205 (cum icone xylogr.).

"*Os* cirrhis brevibus quatuor cinctum. *Cauda* papilla suctoria subglobosa mucrone brevi aucta. Longit. fem. ad $\frac{3}{4}'''$.

"*Hab.* Prope Charkoviam."—*Czernay.*

32. HEMIPSILUS, Quatrefages.

GEN. CHAR. "*Corpore* fere cylindrico; *cauda* acuta, nuda; *capite* truncato, rotundato, setis circumdato; parte anteriore corporis setarum paribus lateralium retro decrescentium armata."

1. H. ——, Quatrefages.

Ann. des Sc. Nat. 3^{e} sér. tom. vi. (1846) p. 131.

"Un peu obtus en avant, le corps se renfle très-légèrement dans son milieu, et se termine en pointe aiguë. Près de l'extrémité antérieure se trouvent six soies placées en cercle d'une manière symétrique autour du corps . . . . . .

"La trompe est forte et musculeuse; elle occupe environ le quart de la cavité du corps. Au point où se joignent la trompe et l'intestin, on trouve quatre corps glandulaires qui semblent déboucher dans l'œsophage.

"L'appareil genital s'ouvre à peu près vers le milieu du corps. La verge est formée par un spicule unique recourbé. À sa base sont quatre poches à parois épaisses, deux grandes et deux petites; des muscles très-apparents servent à le mouvoir."

2. H. TRICHODES, Leuckart.

Leuckart, Archiv für Naturgeschichte, 1849, Band i. p. 157.
Eberth, Untersuch. über Nemat. p. 16.

3. H. AMPHACANTHUS, Grube.

Grube, Archiv für Naturgeschichte, 1855, Jahrg. 21, Bd. i. p. 153.
Eberth, Untersuch. über Nemat. p. 17.

33. PHANOGLENE, Nordmann.

GEN. CHAR. "*Corpus* capillare, retrorsum acuminatum. *Caput* corpore continuum, truncatum. *Os* terminale, bilabiatum, cirrhis 2–4. *Ocelli* ruberrimi in cervice. *Penis* filiformis, vagina tubulosa exceptus; feminæ apertura genitalis . . . ."
"Aquarum dulcium incolæ."

1. P. BARBIGER, Nordmann.

Phanoglene barbiger, Nordmann, in Lamarck's Anim. sans Vert. 2de édit. iii. 664.—Dujardin, Hist. Nat. des Helminthes, 238.

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[1] This account of the genus and species of *Amblyura* has been taken from Diesing's Syst. Helminth. vol. ii. p. 126, and his 'Revision der Nematoden," *loc. cit.* p. 624.

"*Os* cirrhis quatuor instructum. *Ocelli* duo discreti. Longit . . . ."

"*Hab.* In aqua stagnante prope Berolinum (*Nordmann*)."

2. P. MICANS, Nordmann.

Phanoglene micans, Nordmann, in Lamarck's Anim. sans Vert. 2^de^ édit. iii. 664.—Dujardin, Hist. Nat. des Helminthes, p. 238.

"*Os* cirrhis duobus instructum. *Ocelli* coaliti. Longit . . . ."

"*Hab.* In larva Neuropteri (*Nordmann*)"[1].

In all probability, this was a mere accidental tenant of the intestine of the Neuropterous larva in which it was found by Nordmann—having been swallowed with its food. The presence of ocelli renders it almost certain that it could not be an habitual parasite; and the experiments of Davaine (Recherches sur l'Anguillule du Blé niellé, p. 64) have demonstrated that these Nematodes pass uninjured through the intestinal canal of many of the invertebrate and cold-blooded vertebrate animals.

The only freshwater genus in which I have yet met with species possessing ocelli has been *Monhystera.*

The three following marine species I am very uncertain about, and have therefore merely followed Eberth in allowing them to remain in this genus.

3. P. ROSEA, Eberth.

Lineola rosea, Kölliker, Verhandl. d. Naturforsch. Gesell. in Zürich, 1845.—Eberth, Untersuch. über Nematod. p. 18.

"Rosenrothe Farbe, Kopf dreilappig, stumpf, Mundhöhle unbewaffnet, Fühler gleich lang, an der basis der Kopflappen; seitlich an der Speiseröhre zwei braune viereckige Flecken."—*Eberth.*

4. P. OBTUSICAUDATA, Eberth.

Lineola obtusicaudata, Kölliker, Verhandl. d. Naturf. Gesell. in Zürich, 1845.—Eberth, Untersuch. über Nematod. p. 18.

"Kopf noch stumpfer, und die braune Flecken noch einmal so gross, von 0·066‴, Fühler sehr kurz, 0·001–0·0013‴ lang, vier fast ganz vorn, zwei etwas weiter hinten, alle mit dicker in der haut steckender Basis, Schwanz stumpf, kurz, 0·0033″ lang. Penis sehr kurz, von 0·015‴.—*Eberth.*

5. P. FLUSTRÆ, Eberth.

Eberth, Untersuch. über Nematod. p. 18.

Ascaris Flustræ, Dalyell, 'The Powers of the Creator displayed in the Creation,' vol. ii. 1853, p. 92, pl. x. fig. 27.—Leuckart, Archiv für Naturges. 1859, Jahrg. 25, Bd. ii. S. 101 u. 146.

"Length half a line; body slender, nearly cylindrical; extremities acute. Colour dark grey or brownish, with a darker line in the centre of the anterior extremity, denoting an internal organ. Two very conspicuous black specks, resembling eyes, are seated just at the origin of the anterior pellucid part.

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[1] The account of this genus, so far, has been taken from Diesing's 'Syst. Helminth.' p. 128.

"Some of these animals appeared among a number of the decaying corpuscula from the *Flustra carbasea*, which they frequently penetrated as if in quest of food."—*Dalyell.*

34. PONTONEMA, Leidy.

Proceed. of Acad. of Philad. vol. viii. (1856) p. 49.

GEN. CHAR. "Body capillary, narrowing towards the extremities. Head continuous with the body, truncated or obtuse, and surmounted with angular papillæ, cirrated. Eyes none. Tail obtuse. Generative aperture ventral, near the middle of the body. Œsophagus long, cylindro-clavate; gizzard none, intestine straight, capacious; anus ventral and posterior."

1. P. VACILLATUM, Leidy.

Journ. Acad. Philad. 2nd ser. iii. 144, et in Proceed. Acad. Philad. viii. (1856) p. 49.

"Body cylindroid anteriorly, with longitudinal rows of short cirri in addition to those of the head; posteriorly incurved; tail short, thick, conical, obtuse. Length to 9 lines; breadth to ⅕th of a line."

"*Hab.* Found on the sea-shore of Rhode Island, beneath stones, between tides."

2. P. MARINUM, Leidy.

Journ. Acad. Philad. 2nd ser. iii. 144, et in Proceed. Acad. Philad. viii. (1856) p. 49.

"Body cylindroid; head convex; mouth surrounded with angular papillæ. Cirri 4, at the side of the head. Tail long, narrow, conical, obtuse. Length to 3 lines."

"*Hab.* Found at the bottom of a sound on the coast of New Jersey."

3. P. MÜLLERI, Diesing.

Vibrio Anguillula d. Anguillula marina, Müller, Anim. Infus. 66, Taf. ix. 9–11.

Vibrio marina, Bory, in Encycl. Méth. (1824) 778, tab. xxiv. 26.—De Blainville, in Dict. d. Sc. Nat. lvii. 537, et lviii. 71.

Anguillula marina, Oerst. De region. marin. 1844, 63 & 69.

Enchelidium marinum, Ehrenb.—Diesing, Syst. Helm. i. 127 (partim).

"*Corpus* subæquale, retrorsum acutatum. *Caput* truncatum. *Os* cirrhis . . . . Longit. ad 1‴."

"*Hab.* Inter mucosa palos marinos obvestientia, et in aqua marina servata frequentissime (*O. F. Müller*). In profunditate 0–8 orgyiarum, æstate, in fretu Oeresund (*Oersted*)."

"Cum *Vibrio marina*, Müller, ocellis omnino destituta sit, cum *Enchelidio marino*, Ehrenberg, identica esse non potest (*Oersted*, l. c.)."—Sitzungsb. der Kais. Akad. 1861, (Bd. xlii.) S. 623.

35. POTAMONEMA, Leidy.

Proceed. of Acad. of Philad. viii. (1856) 49.

GEN. CHAR. "Body filiform, narrowing towards the extremities. Head continuous with the body, slightly dilated, obtuse. Mouth large, infundibuliform, unarmed. Œsophagus narrow, flexuous, membranous, gradually expanding into a capacious, straight, cylindrical intestine; anus none (?) or exceedingly indistinct. Caudal extremity obtuse. Generative aperture of the female near the middle of the body."

P. **NITIDUM**, Leidy.

"Body cylindroid, most narrowed anteriorly. Head without appendages. Caudal extremity broad, obtusely conical. Length 5 lines; breadth ⅕th of a line."

"An active, wriggling, glistening-white worm, found among beds of *Vallisneria americana* growing in the river Schuylkill, near Philadelphia."

36. NEMA, Leidy.

Proceed. of Acad. of Philad. viii. (1856) 49.

GEN. CHAR. "Body ascaridiform. Head without appendages. Mouth unarmed, large, infundibuliform; œsophagus tubular, membranous, expanding into a simple, straight intestine; anus ventral. Tail conical, acute, recurved. Generative aperture near the middle of the body."

N. **VACILLANS**, Leidy.

"Body white, glistening. Length $1\frac{1}{2}^{mm}$; breadth $\cdot 050^{mm}$. Tail $\cdot 115^{mm}$ long."

"An active, wriggling worm, found about some dead specimens of a black *Phryganea*, which was infested with a fungous parasite, and attached to stones at the water's edge of a small brook near Philadelphia."

37. UROLABES, Carter.

"The generic name of *Urolabes*, which I have employed, should only be viewed as provisional. It has been chosen from the striking habit which all these worms have of attaching themselves to some object by the tail, whether it be by embracing it or by adhering to its surface. Hence the tail would appear to be both prehensile and adhesive, if not suctorial. Having once fixed themselves in this way, they keep up an undulating movement from the tail forwards, which, in the absence of any evident purpose, seems more for respiration than anything else."—*Ann. of Nat. Hist.* ser. iii. vol. iv. p. 99.

Amongst the ten species described by Carter, there are representatives of several genera; and I have been able to assign positions to three of the species—one in the genus *Dorylaimus*, one in *Chromadora*, and one in *Symplocostoma*. Of the remainder, three (*U. glæocapsarum*, *U. labiata*, and *U. tentaculata*) seem, by the form of their œsophagus, almost to belong to the genus *Rhabditis*, although this is somewhat negatived by the absence of caudal alæ in the male of *U. glæocapsarum*, the males of the other two species not having been discovered.

1. U. **GLŒOCAPSARUM**, Carter.

Loc. cit. p. 40, pl. iii. fig. 25.

"*Female*, linear, cylindrical, striated transversely, gradually diminishing towards the head, which is obtuse and without papillæ; also towards the tail, which is long and furnished with a digital termination. Vulva a little anterior to the middle of the body."

"Œsophagus commencing with a cup-like buccal cavity, from which a narrow straight tube extends back to the intestine. Intestine much larger than œsophagus. Muscular sheath of œsophagus commencing a little distance from the buccal dilatation, leaving a portion of œsophagus naked, and then having two swellings in its course, one oval and the other terminal and bulbous. Hepatic organ consisting of a layer of brownish oil-globules, occupying the interval between the intestine and its sheath throughout."

"Organs of generation double, occupying middle third of body."

"*Size*, $\frac{1}{54}''$ long, and $\frac{1}{376}''$ broad."

"*Male*, somewhat smaller than the female; tail somewhat shorter and thicker."

"*Hab*. The *Glœocapsa* which grows on walls and on the sides of gutters during the 'rains,' Island of Bombay."

2. U. LABIATA, Carter.

Loc. cit. p. 41, pl. iii. fig. 26.

"*Female*, linear, cylindrical, unstriated, gradually diminishing towards the head, which is labiated and furnished with two papillæ; also towards the tail, which is conical and elongated. Vulva much behind the centre of the body, about the point of union of the posterior two quarters."

"Alimentary canal and œsophageal and intestinal sheaths, with hepatic organ, the same as in the foregoing species; but no buccal dilatation. Organs of generation probably unsymmetrical, from backward position of vulva."

"*Size*, about $\frac{1}{40}''$ long, and $\frac{1}{774}''$ broad."

"*Male*, unseen."

"*Hab*. The *Glœocapsa* of the walls, &c., during the 'rains,' Island of Bombay."

3. U. TENTACULATA, Carter.

Loc. cit. p. 41, pl. iii. fig. 27.

"*Female*, linear, cylindrical, unstriated, gradually diminishing towards the head, which is obtuse and furnished with two short, thick, conical tentacular prolongations closely approximated at their base and turned outwards; also diminishing gradually towards the tail, which is conical and elongated. Vulva just behind the middle of the body."

"Alimentary canal and hepatic organ much the same as in the two preceding species, but having no buccal dilatation. Organs of generation double, occupying the central portion of the body; their form undetermined."

"*Size*, about $\frac{1}{23}''$ long, and $\frac{1}{26}''$ [?] broad."

"*Male*, unseen."

"*Hab*. The same as the two preceding species."

4. U. CIRRATA, Carter.

Loc. cit. p. 41, pl. iii. fig. 28.

"*Female*, linear, cylindrical, unstriated, gradually diminishing towards the head, which is obtuse and furnished with two linear, short cirri, widely separated; also diminishing gradually towards the tail, which is somewhat curved and obtuse at the extremity. Vulva considerably posterior to the middle of body."

"Alimentary canal the same as in the foregoing species, but without buccal dilatation. Organs of generation undetermined."

"*Size* $\frac{1}{73}''$ long, and $\frac{1}{1080}''$ broad."

"*Male*, unseen."

"*Hab.* Same as foregoing."

5. U. PARASITICA, Carter.

Loc. cit. p. 44, et vol. ii. pl. iv. fig. 50.

"*Female*, linear, cylindrical, unstriated; gradually diminishing towards the head, which is obtuse and without papillæ, and also towards the tail, which is long and conical. Vulva a little in front of the middle of the body."

"Œsophagus commencing in an expanded oral orifice, immediately becoming narrowed into a straight, uniform tube, naked at the commencement, but soon surrounded by a sheath, which goes on increasing in width to the point of union of the œsophagus and intestine, after which it continues of uniform calibre to the termination of the latter. Organs of generation double, occupying the middle third of body."

"*Size*, $\frac{1}{43}''$ long."

"*Male*, unseen."

"*Hab.* Peritoneal cavity[1] of *Nais albida*; in more or less abundance during the 'rains,' when this *Nais* makes its appearance in the *Glœocapsa* mentioned, Island of Bombay.

6. U. ERYTHROPS, Carter.

Loc. cit. p. 42, pl. iii. fig. 29.

"*Female*, linear, cylindrical, minutely striated transversely, ocellated; gradually diminishing towards the head, which is obtuse and without papillæ, also towards the tail, which is long and conical. Vulva just about the middle of body. Œsophagus commencing with a cup-like followed by a globular dilatation, after which it becomes narrow, uniform in width, and pursues a straight course back to the intestine. Intestinal sheath presenting a constriction just after its commencement, which gives it a globular form, part of which only is lined with the hepatic organ. Organs of generation double, occupying the middle third of the body."

"*Ocelli* consisting of two globular bodies, situated a short distance from the head, and between (?) the peritoneal and muscular sheaths of the œsophagus, opake, of a rich carmine colour in their posterior three-fourths, and the anterior fourth or corneal portion bluish opalescent."

"*Size* $\frac{1}{20}''$ long, and $\frac{1}{470}''$ broad."

"*Male*, the same as the female, but with the posterior part of the body terminating more abruptly, and the tail more attenuated."

"*Hab.* Silty clots of *Oscillatoria* floating in the salt-water main drain of the town of Bombay."

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[1] Vide note, p. 77 of this Memoir.

7. U. INFREQUENS, Carter.

Loc. cit. p. 43, pl. iii. fig. 30.

"*Female,* the same as the foregoing species, but a little larger in every way."

"Alimentary canal and organs of generation the same generally. Ova undergoing segmentation; and the embryo developed in the ovisac, but not liberated there."

"*Ocelli,* the same in situation, but semi-opake and of a yellowish colour throughout."

"*Size,* undetermined."

"*Male.* Same as the female, but with a short curved tail, presenting on each side of the inner curvature a membranous expansion supported on setaceous ribs, which extends from the tip of the tail to some little distance above the anus. Organs of generation the same as in the foregoing species; form of testis undetermined."

"*Hab.* The same as last."

Note appended on June 17, 1865.—Whilst this memoir has been going through the press, I have completely satisfied myself of the general correctness of Schneider's views (Reich. and Du Bois-Reym. Archiv, 1863) regarding the nature and arrangement of the nervous system in *Ascaris megalocephala*; and in another memoir, laid before the Royal Society of London on the 15th of this month ("On the Anatomy and Physiology of the Nematoids, Parasitic and Free; with observations on their Zoological Position and Affinities to the Echinoderms"), I have described and figured this system as it exists in *A. lumbricoides*, *A. osculata*, and *A. marginata*. The arrangement which has now been recognized in these and other species, either by Schneider or myself, will, I believe, prove to be the typical condition of the nervous system in the Nematoids generally, although the difficulty of actually demonstrating it is often extreme. I am still of opinion, however, that the so-called "œsophageal ring" met with occasionally in both free and parasitic species is not to be considered a portion of the nervous system of these animals. Reasons for this belief, as well as many new facts and views concerning the anatomy of this interesting group of animals, are contained in my last memoir above mentioned.

ERRATA.

Page 73, [1] omitted before first footnote.
" 78, note, line 12, *instead of* par *read* pas.
" 82, line 22, *instead of* (Schwanzdrüsefi) *read* (Schwanzdrüsen).
" 82, line 31, instead of *Tylelenchus* read *Tylenchus*; and the same in pp. 83 (twice), 84 (twice), 85, 89, 94, 96 (four times), 110, 113.
" 93, *instead of* 7. TRIPULA *read* 7. TRIPYLA.
" 94, *instead of* [c] 21. LINHOMOMIUS *read* [c] 21. LINHOMŒUS.
" 148, line 27, *instead of* 166 *read* 167.
" 165, line 15, *instead of* SPILIPHERA *read* SPILOPHORA.

FREE NEMATOIDS.

EXPLANATION OF PLATES.

The same letters refer to similar parts in all the figures.

a. Mouth.
b. Pharynx.
b'. Pharyngeal teeth.
b''. Pharyngeal processes.
c. Œsophagus.
c'. Median swelling of same.
c''. Terminal swelling of same.
c'''. Valvular apparatus of latter.
d. Intestine.
d'. Hepatic cells.
e. Anus.
e'. Anal glands.
f. Vulva.
f'. Vaginal glands.
g. Male spicules.
g' Accessory pieces.
h. Seminal tube.
i. Supplementary male organ.
k. Abdominal gland.
k'. Excretory orifice of same.
l. Floating gland-cells.
m. Œsophageal ring.
n. Ocellus.
o. Lateral canals.
p. Integument.
p'. Cervical markings of same.
q. Cephalic papillæ.
r. Caudal sucker.
r'. Sucker-tubes.
s. Genital papillæ or suckers.
t. Caudal ala of male.
t'. Rays supporting same.
u. Ovum.
v. Sperm-cell.

Most of the figures are representations of the object drawn to a scale of 150 : 1, *i. e.* are representations magnified 150 diameters—the exceptions being figs. 126–128 and figs. 151–177, all of which are only magnified 100 diameters.

Unless stated to the contrary, the drawings represent the anterior and posterior extremities from a lateral aspect—the animal lying on its side.

Where transverse integumental striæ exist, they are only *represented* on the anterior extremity.

LAND AND FRESHWATER*.

Plate IX.

Figs.
1. *Monhystera dispar*, n. sp.; anterior extremity of female.
2. Posterior extremity of female.
3. *Monhystera rivularis*, n. sp.; anterior extremity of male.
4. Posterior extremity of male.
5. *Monhystera longicaudata*, n. sp.; anterior extremity of female.
6. Posterior extremity of female.
7. *Monhystera filiformis*, n. sp.; anterior extremity of female.
8. Posterior extremity of female.
9. *Monhystera stagnalis*, n. sp.; anterior extremity of female.
10. Posterior extremity of female.
11. Posterior extremity of male.
12. *Monhystera disjuncta*, n. sp.; anterior extremity of male.
13. Posterior extremity of male.
14. *Monhystera ambigua*, n. sp.; anterior extremity of male.
15. Posterior extremity of male.
16. *Tripyla glomerans*, n. sp.; anterior extremity of male.
17. Posterior extremity of male.
18. *Tripyla salsa*, n. sp.; anterior extremity of female.
19. Posterior extremity of female.
20. *Trilobus gracilis*, n. sp.; anterior extremity of female.
21. Posterior extremity of female.
22. Posterior extremity of male.
23. *Trilobus pellucidus*, n. sp.; anterior extremity of female.
24. Posterior extremity of female.
25. *Mononchus truncatus*, n. sp.; anterior extremity of female.
26. Posterior extremity of female.
27. *Mononchus papillatus*, n. sp.; anterior extremity of female.
28. Posterior extremity of female.
29. *Mononchus macrostoma*, n. sp.; anterior extremity of female.
30. Posterior extremity of female.
31. *Mononchus tunbridgensis*, n. sp.; anterior extremity of female.
32. Posterior extremity of female.
33. *Mononchus cristatus*, n. sp.; anterior extremity of female.
34. Posterior extremity of female.

34*a*. *Ironus ignavus*, n. sp.; anterior extremity of female.
34*b*. Posterior extremity of female.

35. *Dorylaimus stagnalis*, Dujardin; anterior extremity of female.
36. Posterior extremity of female.
37. Posterior extremity of male.
38. *Dorylaimus Carteri*, n. sp.; anterior extremity of female.
39. Posterior extremity of female.
40. Posterior extremity of male.
41. *Dorylaimus obtusicaudatus*, n. sp.; anterior extremity of female.
42. Posterior extremity of female.
43. *Dorylaimus tenuicaudatus*, n. sp., anterior extremity of female.
44. Posterior extremity of female.

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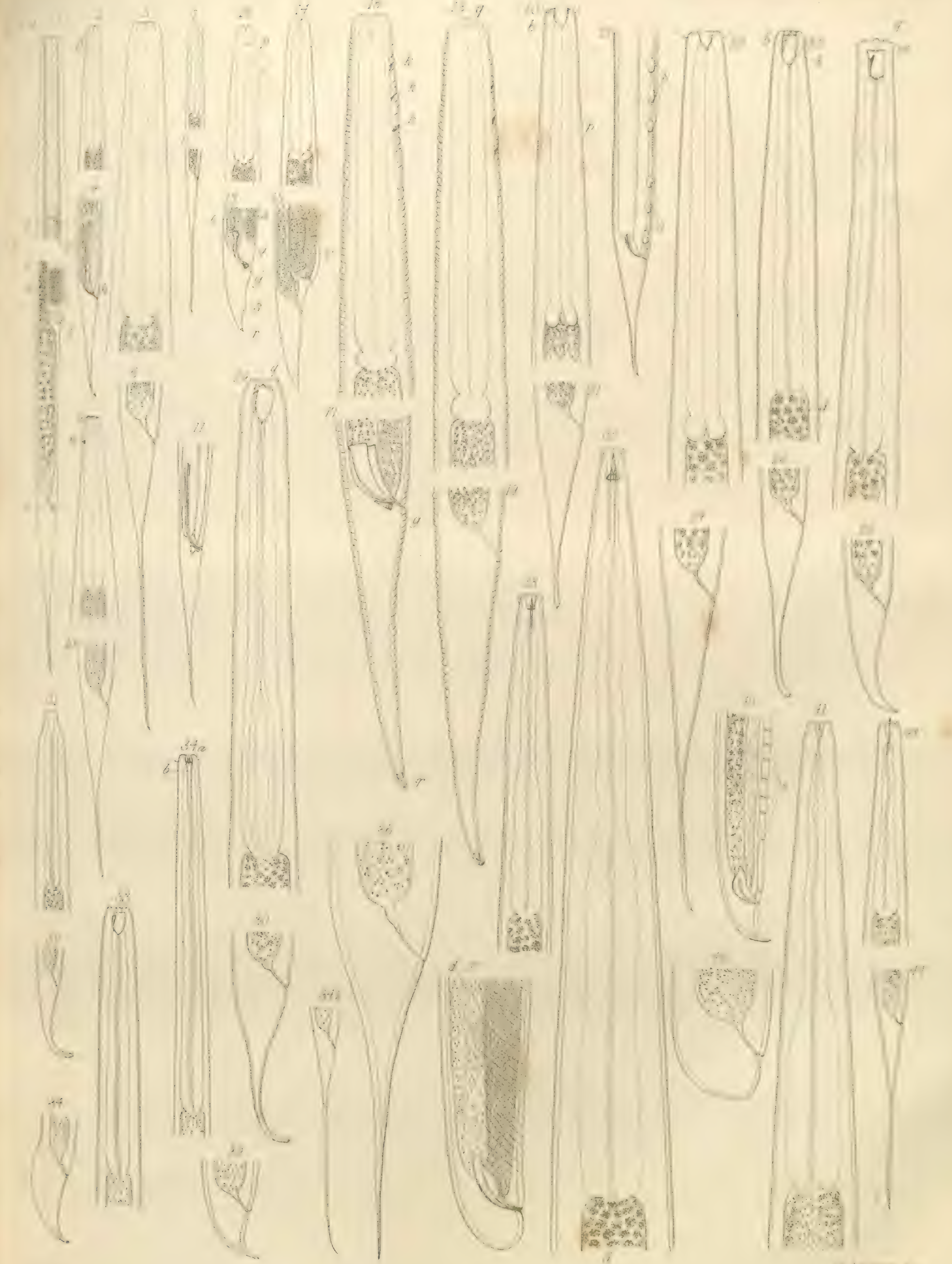
* *M. disjuncta* and *M. ambigua*, and also *Rhabditis marina*, are marine.

PLATE X.

Figs.
45. *Dorylaimus tritici*, n. sp.; anterior extremity of female.
46. Posterior extremity of female.
47. Posterior extremity of male.
48. *Dorylaimus filiformis*, n. sp.; anterior extremity of female.
49. Posterior extremity of female.
50. *Dorylaimus polyblastus*, n. sp.; anterior extremity of male.
51. Posterior extremity of male.
52. *Dorylaimus papillatus*, n. sp.; anterior extremity of female.
53. Posterior extremity of female.
54. *Dorylaimus torpidus*, n. sp.; anterior extremity of female.
55. Posterior extremity of female.
56. Posterior extremity of male.
57. *Dorylaimus iners*, n. sp.; anterior extremity of female.
58. Posterior extremity of female.
59. Posterior extremity of male.
59*a*. *Anguillula aceti*, Ehrenb.; anterior extremity of female.
59*b*. Posterior extremity of female.
59*c*. Posterior extremity of male.
60. *Rhabditis marina*, n. sp.; anterior extremity of female.
61. Posterior extremity of female.
62. Posterior extremity of male.
63. *Rhabditis longicaudata*, n. sp.; anterior extremity of female.
64. Posterior extremity of female.
65. *Rhabditis ornata*, n. sp.; anterior extremity of female.
66. Posterior extremity of female.
67. Posterior extremity of male, ventral aspect.
68. *Rhabditis acris*, n. sp.; anterior extremity of female.
69. Posterior extremity of female.
70. Posterior extremity of male.
71. *Diplogaster fictor*, n. sp.; anterior extremity of female.
72. Posterior extremity of female.
73. Posterior extremity of male.
74. *Diplogaster albus*, n. sp.; anterior extremity of female.
75. Posterior extremity of female.
76. *Diplogaster filiformis*, n. sp.; anterior extremity of female.
77. Posterior extremity of female.
78. Posterior extremity of male.
79. *Plectus parietinus*, n. sp.; anterior extremity of female.
80. Posterior extremity of female.
81. *Plectus cirratus*, n. sp.; anterior extremity of female.
82. Posterior extremity of female.

Figs.
83. *Plectus tenuis*, n. sp.; anterior extremity of female.
84. Posterior extremity of female.
85. *Plectus velox*, n. sp.; anterior extremity of female.
86. Posterior extremity of female.
87. *Plectus acuminatus*, n. sp.; anterior extremity of female.
88. Posterior extremity of female.
89. *Plectus parvus*, n. sp.; anterior extremity of female.
90. Posterior extremity of female.
91. *Plectus tritici*, n. sp.; anterior extremity of female.
92. Posterior extremity of female.
93. *Plectus granulosus*, n. sp.; anterior extremity of female.
94. Posterior extremity of female.
95. *Plectus fusiformis*, n. sp.; anterior extremity of female.
96. Posterior extremity of female.
97. *Aphelenchus avenæ*, n. sp.; anterior extremity of female.
98. Posterior extremity of female.
99. *Aphelenchus villosus*, n. sp.; anterior extremity of female.
100. Posterior extremity of female.
101. Posterior extremity of male.
102. *Aphelenchus parietinus*, n. sp.; anterior extremity of female.
103. Posterior extremity of female.
103*a*. *Aphelenchus pyri*, n. sp.; anterior extremity of female.
103*b*. Posterior extremity of female.
103*c*. Posterior extremity of male.
104. *Cephalobus persegnis*, n. sp.; anterior extremity of female.
105. Posterior extremity of female.
106. Posterior extremity of male.
107. *Cephalobus striatus*, n. sp.; anterior extremity of female.
108. Posterior extremity of female.
109. *Tylenchus Davainii*, n. sp.; anterior extremity of female.
110. Posterior extremity of female.
111. Posterior extremity of male.
112. *Tylenchus* (*Vibrio*) *tritici*, anterior extremity of female.
113. Posterior extremity of female.
114. Posterior extremity of male.
115. *Tylenchus terricola*, n. sp.; anterior extremity of female.
116. Posterior extremity of female.
117. *Tylenchus obtusus*, n. sp.; anterior extremity of female.
118. Posterior extremity of female.
118*a*. Posterior extremity of male.



H.C. Bastian del.

MARINE SPECIES.

PLATE XI.

Figs.

119. *Symplocostoma longicollis,* n. sp.; anterior extremity of female.
120. Posterior extremity of female.
121. Posterior extremity of male.
122. Ventral aspect of anterior extremity, showing buccal apparatus more highly magnified.
123. *Symplocostoma vivipara,* n. sp.; anterior extremity of female.
124. Posterior extremity of female.
125. Posterior extremity of male.
126. *Oncholaimus vulgaris,* n. sp.; anterior extremity of female, showing pigmentary markings of anterior portion of œsophagus only.
127. Posterior extremity of female.
128. Posterior extremity of male.

128*a*. Accessory piece, more highly magnified.

129. *Oncholaimus glaber,* n. sp.; anterior extremity of female.
130. Posterior extremity of female.
131. *Oncholaimus viscosus,* n. sp.; anterior extremity of female, with adherent fragments of sand and Diatomaceæ.
132. Posterior extremity of female.
133. Posterior extremity of male.
134. *Oncholaimus attenuatus,* Dujard.; anterior extremity of female.
135. Posterior extremity of female.
136. Posterior extremity of male.
137. *Oncholaimus viridis,* n. sp.; anterior extremity of female.
138. Posterior extremity of female.
139. *Oncholaimus fuscus,* n. sp.; anterior extremity of male.
140. Posterior extremity of male.
141. *Oncholaimus albidus,* n. sp.; anterior extremity of female.
142. Posterior extremity of female.
143. *Anticoma Eberthi,* n. sp.; anterior extremity of female.
144. Posterior extremity of female.
145. Posterior extremity of male.
146. *Anticoma limalis,* n. sp.; anterior extremity of female.
147. Middle portion of body, showing vagina and vaginal glands.
148. Posterior extremity of female.
149. *Anticoma pellucida,* n. sp.; anterior extremity of female.
150. Posterior extremity of female.
151. *Phanoderma Cocksi,* n. sp.; anterior extremity of female.
152. Posterior extremity of female.
153. Posterior extremity of male.
154. *Phanoderma albidum,* n. sp.; anterior extremity of female, dorsal aspect.
155. Posterior extremity of female.

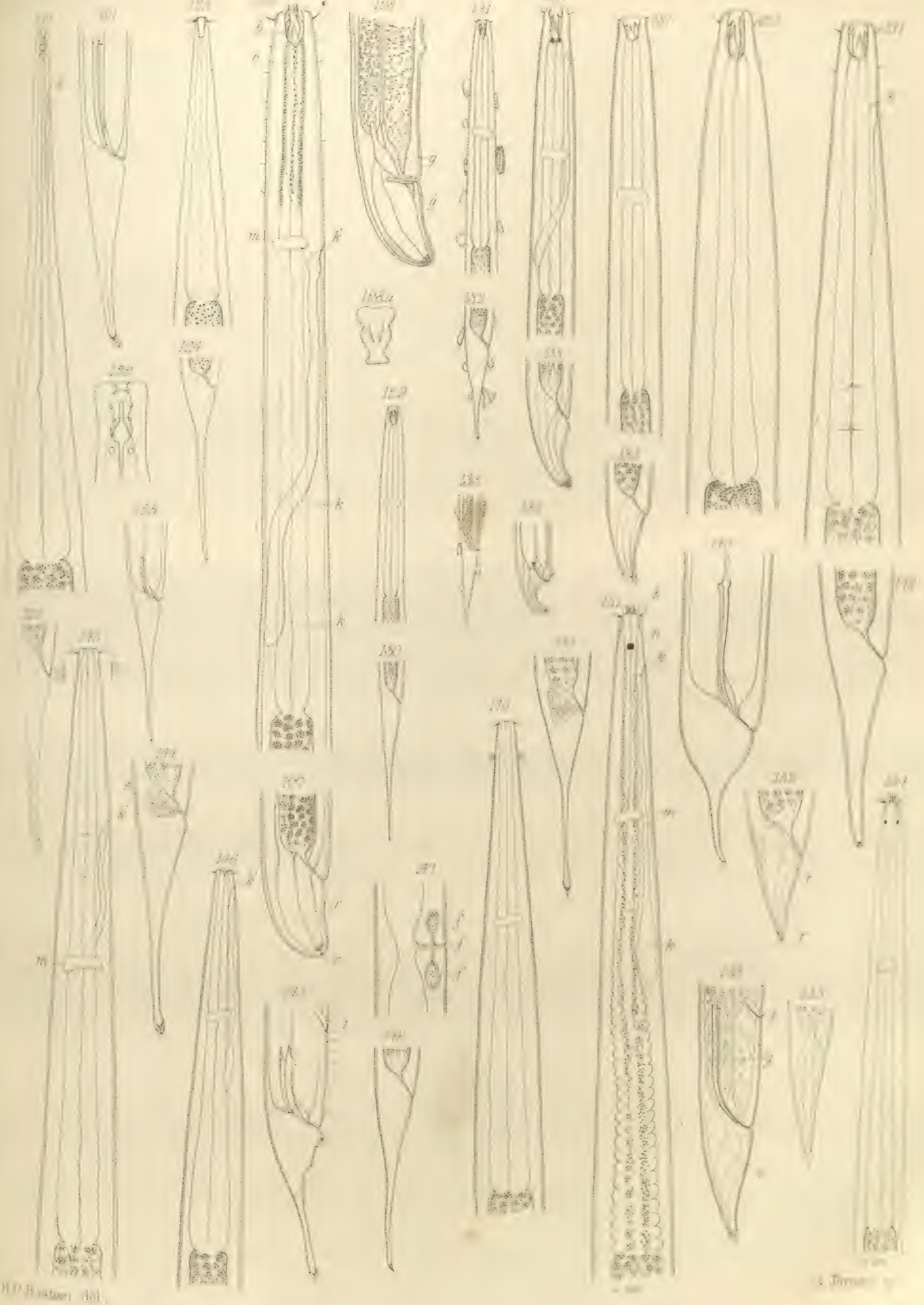

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PLATE XII.

Figs.
156. *Leptosomatum elongatum*, n. sp.; anterior extremity of male, dorsal aspect.
157. Posterior extremity of male.
158. *Leptosomatum gracile*, n. sp.; anterior extremity of female, dorsal aspect.
159. Posterior extremity of female.
160. Posterior extremity of male.
161. *Leptosomatum figuratum*, n. sp.; anterior extremity of female, dorsal aspect.
162. Posterior extremity of female.
163. Posterior extremity of male.
164. *Enoplus communis*, n. sp.; anterior extremity of female[1].
165. Posterior extremity of female.
166. Posterior extremity of male.
167. The three teeth more highly magnified.
168. *Enoplus Dujardinii*, n. sp.; anterior extremity of female.
169. Posterior extremity of female.
170. Posterior extremity of male.
171. *Enoplus pigmentosus*, n. sp.; anterior extremity of female.
172. Posterior extremity of female.
173. *Enoplus inermis*, n. sp.; anterior extremity of female, dorsal aspect.
174. Posterior extremity of female.
175. Posterior extremity of male.
176. *Enoplus brevis*, n. sp.; anterior extremity of female.
177. Posterior extremity of female.
178. *Linhomœus hirsutus*, n. sp.; anterior extremity of female.
179. Posterior extremity of female.
180. *Linhomœus elongatus*, n. sp.; anterior extremity of male.
181. Posterior extremity of male.

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[1] In the members of this genus, the pigmentary markings of the anterior portion of the œsophagus only are represented.

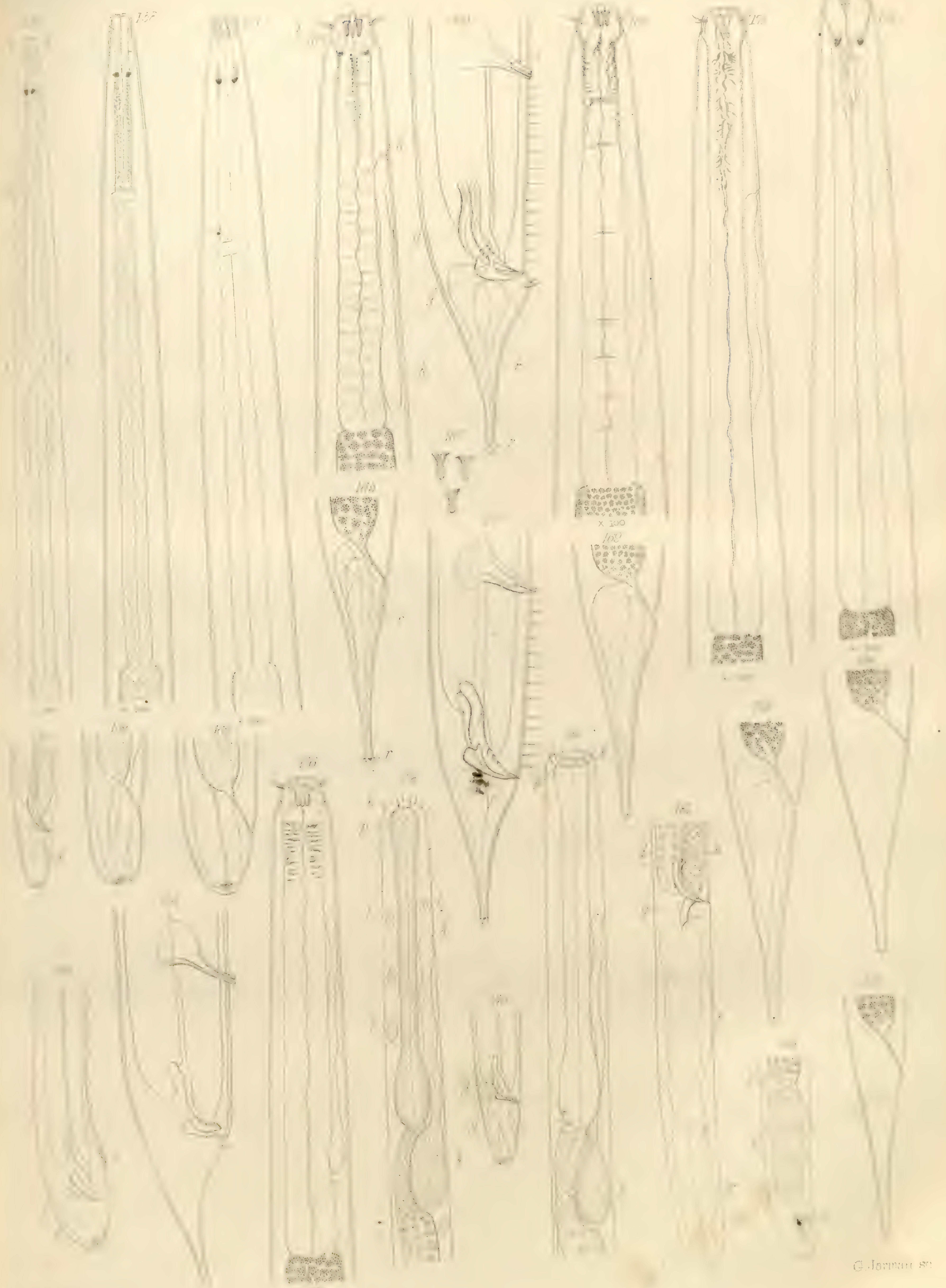

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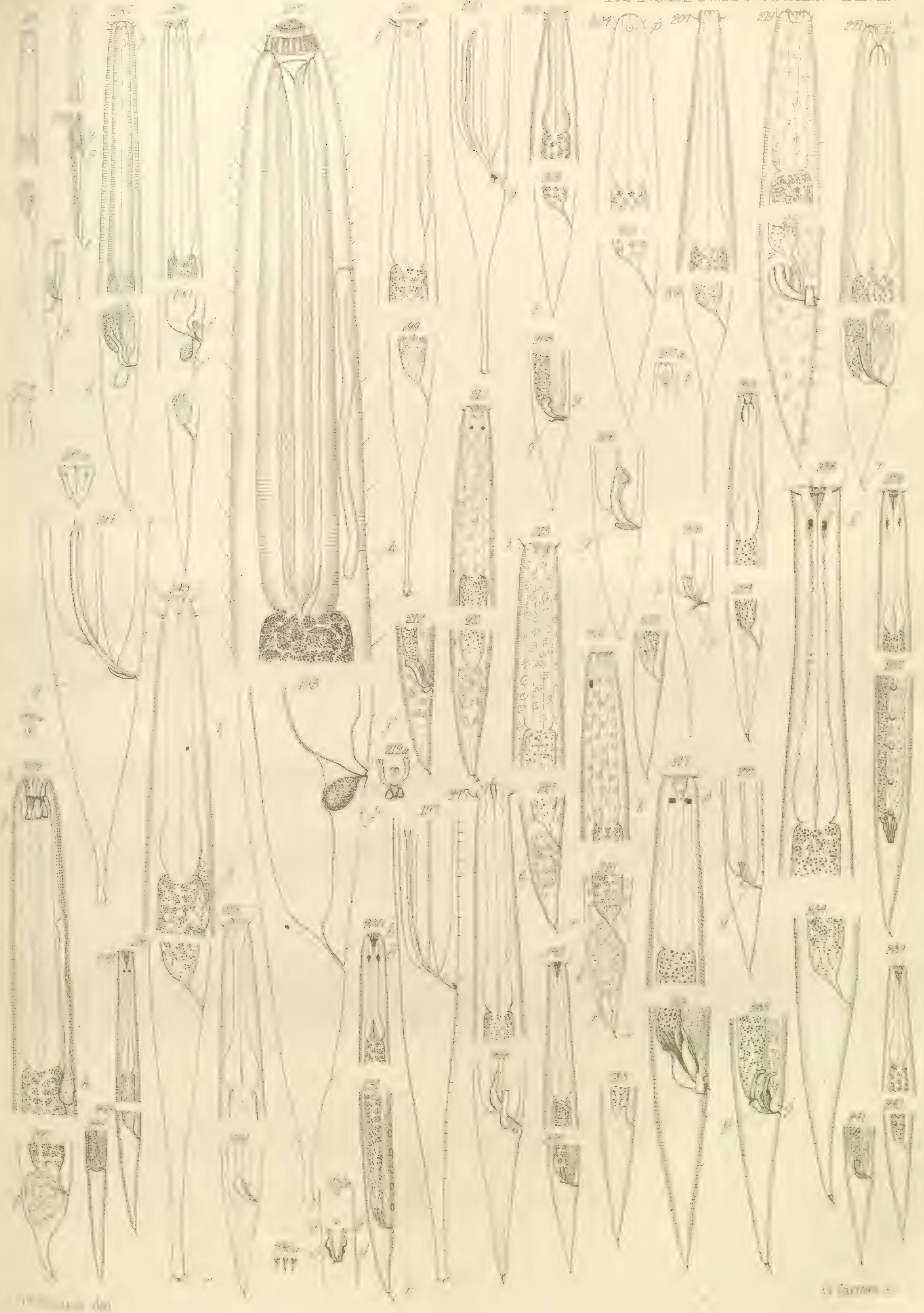
Plate XIII.

Figs.

182. *Tachyhodites natans*, n. sp.; anterior extremity of female.
183. Posterior extremity of female.
184 Posterior extremity of male.
185. *Tachyhodites parvus*, n. sp.; anterior extremity of female.
186. Posterior extremity of female.
187. *Theristus acer*, n. sp.; anterior extremity of male.
187*a*. Anterior extremity seen from above, showing lateral convex projections of integument.
188. Posterior extremity of male.
189. *Theristus velox*, n. sp.; anterior extremity of female.
190. Portion of body, showing vagina and unequal vaginal glands.
191. Posterior extremity of female.
192. *Sphærolaimus hirsutus*, n. sp.; anterior extremity of female.
193. Posterior extremity of female.
194. Posterior extremity of male.
194*a*. Single-grooved accessory piece.
195. *Comesoma vulgaris*, n. sp.; anterior extremity of female.
196. Posterior extremity of female.
197. Posterior extremity of male.
198. *Comesoma profundi*, n. sp.; anterior extremity of female.
199. Posterior extremity of female.
200. Posterior extremity of male.
201. *Spira parasitifera*, n. sp.; anterior extremity of female.
202. Posterior extremity of female.
203. Posterior extremity of male.
204. *Spira lævis*, n. sp.; anterior extremity of female.
205. Posterior extremity of female.
206. Posterior extremity of male.
207. *Spira tenuicaudata*, n. sp.; anterior extremity of female.
207*a*. Lateral aspect of portion of anterior extremity, seen from above.
208. Posterior extremity of female.
209. Posterior extremity of male.
210. *Cyatholaimus ocellatus*, n. sp.; anterior extremity of female.
211. Posterior extremity of female.
212. Posterior extremity of male.
212*a*. Spicules and accessory pieces.
213. *Cyatholaimus cæcus*, n. sp.; anterior extremity of female.
214. Posterior extremity of female.
215. *Cyatholaimus ornatus*, n. sp.; anterior extremity of female.

Figs.

216. Posterior extremity of female.
217. *Cyatholaimus punctatus*, n. sp.; anterior extremity of male.
218. Posterior extremity of male.
219. *Cyatholaimus striatus*, n. sp.; anterior extremity of male.
220. Posterior extremity of male.
221. *Spilophora elegans*, n. sp.; anterior extremity of male.
222. Posterior extremity of male.
223. *Spilophora inæqualis*, n. sp.; anterior extremity of female.
224. Posterior extremity of female.
225. Posterior extremity of male.
226. *Spilophora robusta*, n. sp.; anterior extremity of female.
226*a*. Lateral spiral cervical marking of integument.
227. Posterior extremity of female.
228. *Spilophora costata*, n. sp.; anterior extremity of male.
229. Posterior extremity of male, showing also gradual fading of longitudinal markings.
230. *Chromadora nudicapitata*, n. sp.; anterior extremity of male.
230*a*. Three conical pharyngeal plates.
231. Posterior extremity of male.
231*a*. Portion of body, seen from ventral aspect, showing spicules and median integumental markings.
232. Posterior extremity of female.
233. *Chromadora vulgaris*, n. sp.; anterior extremity of female.
234. Posterior extremity of female.
235. Posterior extremity of male.
236. *Chromadora natans*, n. sp.; anterior extremity of male.
237. Posterior extremity of male, ventral aspect.
238. Posterior extremity of female.
239. *Chromadora cæca*, n. sp.; anterior extremity of female.
240. Posterior extremity of female.
241. Posterior extremity of male.
242. *Chromadora filiformis*, n. sp.; anterior extremity of female.
243. Posterior extremity of female.
244. Posterior extremity of male.
245. *Chromadora sabelloides*, n. sp.; anterior extremity of male.
246. Posterior extremity of male.
247. *Chromadora papillata*, n. sp.; anterior extremity of male.
248. Posterior extremity of male.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III. *Description of some New and Remarkable Species of* Aristolochia *from Western Tropical Africa. By* Jos. D. Hooker, *M.D., F.R.S., V.P.L.S., &c.*

(Plate XIV.)

Read February 16th, 1865.

1. Aristolochia Goldieana, Hook. f.; glaberrima, foliis ovato- vel triangulari-cordatis basi profunde exsculptis acuminatis, floribus maximis, perianthii refracti utriculo elongato subclavato limbo infundibuliformi campanulato ore ampliato truncato obtuse trilobo lobis caudato-acuminatis, staminibus ad 24, columnæ lobis ad 12 bicruribus.

Hab. In Africæ tropicæ occidentalis sylvis ad Eluga a Rev. Episcopo Sierræ Leone detecta (*Barter*, n. 3427). In insula Fernando Po, *Mann*, n. 391. In sylvis ad ostium fluminis Old Calabar, *Rev. W. C. Thomson.*

Frutex scandens, caule 20-pedali, ramulis gracilibus teretibus. *Folia* longe graciliter petiolata, 6–8-poll. longa, 5–6 lata, basi auriculato-cordata sinu profundo lato fere clauso auriculis rotundatis, acuminata, integerrima vel siccitate crenulata, glaberrima, membranacea, subtus pallida; nervis primariis 7–11, arcuatis, a nervo tenui basim cordatam folii marginante orientibus, gracilibus; petiolo 6-pollicari. *Stipulæ* 0. *Perianthium* medio refractum; pars inferior vel utriculus in ovario sessilis, 8 poll. longa, $2\frac{1}{2}$–3 lata, subcylindrica, obtuse 6-costata, apice clavato incurvo, dorso arcuata, subito in limbum perianthii contracta, basi angustata intrusa, intus pilis articulatis mollibus aucta; perianthii pars superior 12 poll. longa, infundibuliformi-campanulata, multicostata, sensim in limbum symmetricum expansa; limbus subinflatus crasse costatus, inter costas lacunosus, ore hiante truncato, obscure trilobo, lobis subito acuminato-caudatis; fauce intus cum lamina circumambiente pendula aucta. *Columna* subsessilis, $1\frac{1}{2}$ poll. longa, $\frac{3}{4}$ poll. diametro, intus cava, cavitate infundibuliformi. *Antheræ* anguste lineares, contiguæ, 1 poll. longæ, columnæ adhærentes. *Stigmata* erecta, apicibus bifidis incurvis.

Plate XIV. fig. 1, flower; 2, branch and leaves; 3, longitudinal section of the throat of the perianth, showing the position and form of the pendulous curtain; 5, hair from cavity of the utricle; 6, vertical section of the base of the utricle, showing the column; 7, vertical section of the column; 8, upper part of anthers and stigma; figs. 3, 5, 7, and 8, *all magnified.*

For the specimen, preserved in alcohol, from which the drawing of this magnificent plant has been made, I am indebted to the Rev. W. C. Thomson, by whom it was found growing in forests near the mouth of the Old Calabar river in 1863, and to whom we are indebted for many interesting plants collected in the same region. At Mr. Thomson's request, it is named after his fellow-labourer, the Rev. Hugh Goldie, of the United Presbyterian Missionary Society.

The most remarkable characters in the structure of *A. Goldieana* are,—1. the number of stamens, which, in all the 160 species hitherto described, are either six or very rarely five, but here amount to about twenty-four, whilst in two other West-African species, hereafter to be described, they are ten or twelve as in the Malayan genus *Thottea*, which they further resemble in the 3-lobed perianth, but from which *A. Goldieana* differs in the anthers being sessile, inserted in a single series, and in the 6-celled ovary; 2. the number of styles or divisions of the column, which are about twelve, each bifid, the highest number in described species being six. In habit, size of flower, and colour it resembles the American *A. gigantea*, Mart. & Zucc., but differs entirely in the form of the perianth and structure of the column.

Another novel point in this flower, but of which more information is wanted, is the swollen and apparently glandular apices of the stigmatic crura. The true position of the stigmatic surfaces is, in other species, marginal and decurrent on the lobes; and if so in this, it is possible that the glands may be secretory organs, whose object may be to attract insects to the column, their agency being obviously essential to fertilization—or, as is the case with the rostellum of some orchids, to aid the transport of pollen by supplying the viscid matter which adheres to the limbs of insects.

The colour of the flower is, according to description, violet, more or less variegated with yellow and red-purple; and the odour, according to the Bishop of Sierra Leone, resembles that of decaying fungi.

2. A. TRIACTINA, Hook. f.; glaberrima, foliis coriaceis circumscriptione subhastato-oblongis auriculato-trilobis coriaceis basi profunde cordato-bilobis, lobis lateralibus rotundatis sub-2-lobulatis, intermedio oblongo acuminato, perianthii curvati utriculo inflato gibbo, tubo cylindrico, limbo explanato 3-lobo lobis patentissimis caudato-acuminatis, staminibus 10, lobis columnæ subulatis integris.

Hab. In Africa tropica occidentali ad ostium fluminis Gaboon in Corisco Bay, *Mann*, n. 1851, Septembri 1862.

Caulis volubilis, 25-pedalis, tenuis, lævis, glaberrimus. *Folia* petiolata, 2–5 poll. longa, $1\frac{1}{2}$–3 lata, subcoriacea, superne nitida, lævia, subtus reticulatim nervosa subconcoloria, nervis primariis 3–5 nervulisque prominulis, sinu profundo rotundato aperto vel clauso, lobis lateralibus obtusissimis, subsinuatis; petiolo $\frac{2}{3}$–$1\frac{1}{2}$ poll. longo. *Stipulæ* 0. *Pedunculi* ad 2 poll. longi. *Perianthium* 2–3 poll. longum, plus minus curvum; utriculus 1–$1\frac{1}{2}$ poll. longus et latus, oblique obovoideus, dorso truncato membranaceus, sub-6-costatus; tubus ad $1\frac{1}{2}$ poll. longus, fere 1 poll. diametro, teres, ad 12-nervus, ore modice contracto ciliato; limbus 4 poll. diametro, ad basin trilobus; lobi patentes plani, subæquales, subulato-lanceolati, caudato-acuminati, glaberrimi, marginibus ciliatis. *Columna* parva, sessilis. *Antheræ* 10. *Stigmatis* lobi 10, subulati, indivisi (?). *Capsula* 10–12-pollicaris, 1–$1\frac{1}{2}$ poll. diametro, 6-costata, costis elevatis, crasse coriacea.

3. A. MANNII, Hook. f.; foliis breviter petiolatis 5-lobis basi cordato-bilobis subtus nervosis pubescentibus, lobo medio oblongo acuminato, lateralibus brevibus rotundatis, floribus breviter racemosis, perianthii utriculo parvo inflato, tubo curvo sensim dilatato, ore truncato obscure 3-lobo.

Hab. In Africa tropica occidentali ad ostia fluminis Old Calabar, *G. Mann*, n. 2323, Feb. 1863.

Caulis volubilis, crassiusculus, 10–15-pedalis, teres, glaber. *Folia* ampla, 6 poll. longa 4–6 lata, dure coriacea, superne glaberrima subnitida, subtus opaca puberula, nervis elevatis creberrime reticulata,

basi profunde 2-loba, lobis imbricatis, sinu angustissimo clauso, lobo intermedio oblongo vel obovato-oblongo abrupte acuminato, 2 lateralibus utrinque valde inæqualibus, inferiore minore rotundato, superiore ascendente oblique oblongo obtuso interdum obscure sinuato vel repando 2-lobo: nervis folii primariis 5 secundariisque validis; petiolo 1-1½ poll. longo, robusto. *Stipulæ* 0. *Flores* breviter racemosi, rachi ½-1 poll. longo, puberulo; bracteæ parvæ, ovato-subulatæ. *Pedunculus* cum ovario pollicaris. *Perianthium* 3 poll. longum, membranaceum, glabrum; utriculus ⅓ poll. longus, obovoideo-globosus, gibbus, intus lanuginosus; tubus lente curvus, 2½ poll. longus, sensim dilatatus, basi ⅓ apice 1½ poll. diametro; ore aperto non ampliato, oblique truncato, obscure 3-lobo, non ciliato, intus fasciculis parvis pilorum obsito. *Columna* parva stipitata, stipite antheris æquilongo. *Antheræ* 10, lineares. *Stigmatis* lobi 10, subulati, indivisi (?).

Fitch, del. et lith

Vincent Brooks Imp

ARISTOLOCHIA GOLDIEANA, H.f.

IV. *On the Anatomy of* Doridopsis, *a Genus of the Nudibranchiate Mollusca.*

By ALBANY HANCOCK, *F.L.S.*

(Plates XV.–XX.).

Read January 19th, 1865.

DORIDOPSIS has until lately* been confounded with *Doris*, which, indeed, it very closely resembles,—though it may always be distinguished by the position and character of its mouth, and generally by the softness of its dermal envelope, which is devoid of spicules, granules, or any other calcareous bodies whatsoever. It is also usually more elongated, with the sides parallel, and is frequently vividly coloured. Six or seven species have been described, all from Madras†. A castaneous species also occurs in Madeira. They divide themselves naturally into two principal groups, one of which is characterized by the smoothness of the mantle, the other by its being covered with soft, warty tubercles.

The species mainly relied upon on this occasion belongs to the latter division, and has been named *D. gemmacea.* It is three or four inches long, and is rather narrow in proportion to its length, with the mantle covering the head and foot, the latter projecting only a little behind when the animal is moving. The pallial tubercles are compound, and are placed symmetrically in three rows along the back and sides, with smooth lozenge-shaped spaces between them. The head is inconspicuous, bulging forward a little in front of the anterior margin of the foot, and having the sides produced into short angular points. The mouth is in the form of a small circular aperture, placed a little backward in a depression or cleft in the thickened margin of the foot. The dorsal tentacles are retractile within cavities, are placed well forward, and are clavate, with the upper portion laminated. There are five retractile branchial plumes, which are quadripinnate; they are placed towards the posterior extremity of the middle line of the back, surrounding the anal nipple and renal orifice. The genital opening is placed well forward, on the right side, between the mantle and foot. The foot is rounded at both extremities, a little more abruptly in front than behind, where it projects slightly beyond the mantle when the animal is crawling. In front, the margin is thickened and cleft in the centre, the mouth-opening in the cleft; in some species a little behind it, where there is a smooth area extending from side to side, and bounded backward by a ridge which indicates, apparently, the true margin of the foot, the thickened margin in front being the representative of the anterior lamina in *Doris*. (Pl. XV. fig. 3, and Pl. XX. figs. 3 & 4.)

Though this species is stated to be three or four inches long, the spirit-specimens dissected were scarcely more than one inch and a half in length.

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* It was described in 1863 by Messrs. Alder and Hancock, in a paper on Madras Nudibranchs in the 'Transactions of the Zool. Soc.' vol. v. p. 124.

† *Ibid.*

Doridopsis nigra has also been dissected, and will be used in this paper as the type of the smooth division to which it belongs. It differs from *D. gemmacea* chiefly by the smoothness of the mantle. The branchial plumes, too, are tripinnate, and are eight in number. The specimens dissected were about one inch and a half in length.

Besides these two species, reference will likewise be made to *D. tuberculosa*, *D. clavulata*, *D. miniata*, and one or two others.

On laying open the dorsal skin of *D. gemmacea* (Pl. XV. fig. 1), the whole of the viscera are found to be packed together beneath a thin delicate membrane, similar to that which in *Doris* has been named the peritoneum *. This membrane is attached along the sides to the inner surface of the skin, and, behind, to the anterior margin of the pericardium, and seems to furnish a pretty complete lining to the visceral cavity. It is perforated with numerous circular orifices (*c*), no doubt for the passage of the blood from the visceral cavity to the skin on its way to the heart.

The anterior extremity of the alimentary canal is seen in front as a constricted tube, passing through the nervous collar. On the right, in front, is the great bulk of the reproductive organs; on the left, and further back, the liver-mass, with the anterior stomach or crop lying between it and the genitalia. At the posterior extremity of the visceral cavity, above the liver, is the heart enclosed within the pericardium, which is apparently enveloped in a fold of the peritoneum.

Digestive System.—The mouth (Pl. XVIII. fig .1) opens downwards and forwards, in a depression or cleft in the thickened anterior margin of the foot, and is a small circular orifice; there are no fleshy lips as in *Doris*, but it leads at once into a rather wide chamber, with strong muscular walls (Pl. XVIII. fig. 1 *b*). From the inner surface of the posterior wall of this chamber or sac, a nipple-formed proboscis (*d*) projects exactly in a line with the oral or outer orifice (*c*). The proboscis is perforated in front, and is formed by the invagination of the posterior wall of the sac; and on laying it open (Pl. XVII. fig. 2) it is found to enclose the anterior extremity of the alimentary tube, the wall of which, in front, is fused with that of the proboscis around the perforation; or, in other words, the extremity of the alimentary tube forms the inner wall of the proboscis, the outer wall being nothing more than the posterior wall of the sac reflected over it.

Two or three stout muscular bands (Pl. XVI. fig. 3 *k*) pass from either side of the sac or sheath of the proboscis, and, stretching backwards, become attached to the skin at the sides of the body. These are the retractors of the proboscis or sheath, and are the homologues of the retractors of the oral channel in *Doris*, the sac or sheath being the true representative of the channel of the mouth in that animal. A few minute threads (Pl. XVIII. fig. 1 *h*), apparently muscular, pass backwards from the wall of the sac to the outer surface of the alimentary tube, which probably regulate the action of the parts on the exsertion of the proboscis.

For some distance behind the sac or sheath, the alimentary tube continues constricted (Pl. XVI. fig. 3 *l*), and must, in fact, form the inner wall of the proboscis when that organ is exserted. The tube then rather suddenly dilates (*m*), and is shortly again constricted. Behind, at each side of the dilated portion, is placed a glandular nodule (*o*), which opens into the tube. These are undoubtedly rudimentary salivary glands; and as their representatives in *Doris* open through the posterior wall of the buccal organ, it would appear that this dilated portion represents that organ, and the constricted part in front, which we have seen forms the inner wall of the exserted proboscis, corresponds to its narrow or anterior extremity. Thus it would appear that this dilated portion, with the anterior constricted part of the alimentary tube, is really the buccal organ modified.

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* "On the Anatomy of *Doris*," by Albany Hancock and Dennis Embleton, M.D., Phil. Trans. 1852, p. 208.

The whole of the walls of this modified organ are muscular, the fibres, for the most part, being longitudinal and transverse. In the constricted portion, however, the walls are much thinner than in the dilated part, in which they are stout and firm. The inner surface of the whole (Pl. XVII. fig. 2 *g*, *h*) is divided into four longitudinal areas, but otherwise is quite smooth, the mucous membrane being entirely without wrinkles. There is no armature whatever, nor any process indicating a rudimentary condition of the tongue, so universal in the Nudibranchs,—the only exceptions being *Tethys* and *Melibe*, which are alike deficient in this respect: in these instances, however, the mouth is not transformed into a proboscis.

The exsertion of this proboscidiform mouth through the oral aperture must be effected by the pressure of the fluid in the visceral chamber, aided, perhaps, by the muscular contractions of the walls of the sac or sheath. The sac itself will be everted much in the same manner as are the tentacles of a snail, the proboscis being attenuated and elongated by the contractions of the transverse muscles in its wall. The retraction of this organ, we have already seen, is provided for by the muscular bands passing from the posterior wall of the sac or sheath to the skin at the sides of the body.

Besides the rudimentary salivary glands before mentioned, there are two large folliculated glands (Pl. XVII. figs. 1 & 2, *j* & *i*), which lie in front beneath the proboscis, and pour their secretion by a single slender duct into this organ immediately within the orifice. These glands are of a pale yellowish colour, and their ducts unite almost at once to form one common duct, which is at first considerably dilated, thus providing apparently a receptacle for the secretion; it then gradually tapers forward and, after a short course, sinks into the muscles of the foot, but may still be followed by dissection until it opens into the proboscis, just within the margin of the orifice, by a minute puncture (figs. 2 *b* & 3 *d*).

It is not easy to conjecture the nature of the fluid secreted by these glands. It can scarcely be salivary; for we have seen that the true salivary glands occupy the usual position, and, though minute, they may be deemed sufficient when we take into consideration the simple nature of the buccal apparatus, which is here reduced to a mere suctorial tube. Can the secretion thus supplied be a solvent to enable the animal to penetrate the calcareous coverings of its prey, and so to reach its food? Or may it be of a poisonous nature, to paralyze or benumb its victims? The feeble structure of the buccal organ seems to suggest the requirement of some such aid, as, in these animals, there is neither cutting nor prehensile organ of any kind.

Immediately behind the true salivary glands the œsophagus commences (Pls. XV. & XVII. fig. 1). At this point of the alimentary tube we have seen that there is a constriction; it at once again dilates and passes to the left, then turns to the right, and, crossing diagonally backwards, is once more attenuated and sinks into the anterior surface of the liver on its way to the true stomach, which is buried in that viscus. The œsophagus, which is considerably longer than the proboscis, has it walls somewhat folliculated, and forms a sort of crop or anterior stomach (Pl. XVII. fig. 2 *m*), which has its mucous membrane thrown into numerous wrinkles, giving to the surface a honeycombed appearance.

The stomach (Pl. XVI. fig. 2) is rather large, lies in the centre of the liver, and partakes considerably of the form of that organ, being rounded in front and bilobed behind. Its inner surface presents numerous large irregular depressions, within which are many smaller depressions (*g*) divided by elevated ridges, giving to the whole a coarsely reticulated appearance. There can be little doubt that these depressions, large and small, are the biliary ducts, which have lost their tubular character, and are reduced to mere openings or depressions in the substance of the liver. Be this, however, as it may, there are no distinct channels or ducts, properly so called, for the passage of the hepatic secretion; and it is evident enough that the bile must enter the stomach through the cell-like depressions that everywhere exist in its walls. Indeed the stomach may be looked upon as a much-folliculated sac with the hepatic matter suffused over the surface, and giving its secretion everywhere through the walls of the follicles. Here, then, we have a very interesting modification of the hepatic organ; for we see in it, in this instance, an intermediate step in development between the complete specialization of the organ in the *Dorididæ* and the more or less fusion of it with the stomach in the *Eolididæ*.

A very delicate mucous membrane may be traced, in minute folds, on the ridges that separate the cells in the gastric wall.

The liver (Pl. XVII. fig. 1 *m*) is of a brownish-yellow colour; it is large and elongated, with the anterior margin enlarged a little, rounded, and slightly hollowed. Behind, it is cleft for some distance into two lateral lobes (*n*), which pass backwards, one on each side of the branchial circle.

The intestine (*o*) issues from the dorsal wall of the stomach a little behind the œsophagus, and penetrates through the upper surface of the liver. It is rather dilated at the pyloric extremity (Pl. XV. fig. 1 *h*), and, turning forwards and to the right, it almost immediately doubles upon itself, and then, taking a backward course, passes under the pericardium, and soon terminates at the anal nipple, situated in the centre of the branchial circle. Its walls are rather delicate, the muscular layer being thinner than usual, and the mucous membrane not by any means strong. The latter rises into delicate longitudinal folds, which are best defined in the dilated portion near to the pyloric extremity, where there is one fold, very much larger than the rest, that is continued into the stomach (Pl. XVI. fig. 2 *f*).

The alimentary system of *D. nigra* (Pls. XV. & XVI. figs. 2 & 1) varies very slightly from that of *D. gemmacea*. The dilated portion behind the proboscis is scarcely distinguishable, as it is only a very little wider than the proboscis itself. The crop or anterior stomach is well developed, and the constriction before and behind marks it off with great emphasis. The mucous membrane of the latter (Pl. XX. fig. 1 *e*) is wrinkled much in the same manner as it is in *D. gemmacea*; and the proboscis (*b*) is quite smooth in the interior, exhibiting only the three or four peculiar longitudinal areas above described in that species. Here, likewise, there is no armature whatever, either in the form of tongue, jaws, or collar; and it may be stated that I have examined with great care the oral organ of six or seven species with the same negative result. The intestine of *D. nigra* is a short constricted tube (Pl. XV. fig. 2 *m*, & Pl. XVI. fig. 1 *g*), and passes backwards at once on reaching the surface of the liver, which is large, elongated, hollowed in front, bifid behind, and of a brownish-yellow hue.

In *D. atromaculata* the proboscis is quite slender, and tapers imperceptibly into the crop or anterior stomach, which is well developed. No external head is visible in this species, which in other respects is abnormal. The oral aperture is minute, and is situated immediately in front of the margin of the foot, differing in this respect from that of all the other species, in which the mouth invariably opens through the anterior margin or immediately behind it. In them, however, this margin seems to be formed by a lamina similar to that so common in *Doris*; while in the species before us there is no appearance of such lamina.

The alimentary tube of *D. miniata* is in some respects a little modified. The head is small and inconspicuous; the mouth is very minute, and opens in the usual way in a cleft in the anterior margin of the foot. The proboscis, in one of the individuals examined, was exserted, and was found to be long and slender. The inner or posterior portion is not dilated, but forms, in continuation with the part corresponding to the crop or anterior stomach, a long, constricted œsophagus, which extends nearly from one end of the body to the other, reaching, in fact, nearly to the posterior extremity of the liver. The intestine passes from the upper surface of that viscus, and is considerably dilated at first; it stretches for some little distance forwards, and then turns to the right and, suddenly bending backwards, runs beneath the pericardium much reduced in calibre and, ends in an anal nipple situated not, as usual, in the centre of the branchial circle, but at the left side, and close to the base of the plumes, there being two before and three behind a transverse line drawn through it.

Reproductive System.—The generative organs are arranged upon the same plan as in other Nudibranchs; they are hermaphrodite, being composed of male, female, and androgynous parts, differing in no material manner from those in *Doris*.

The ovary (Pl. XV. fig. 1 *k*) is lobulated, and is spread over the anterior of the liver; all the other parts (*j*, *j*) are placed well forward on the right side, and extend backwards about one-third the length of the body. Between the mantle and foot there is a common orifice that leads into a very shallow vestibule, through the inner wall of which are three openings, one for the exsertion of the penis, another leading to the androgynous organs, and the third to the female channel.

The male and androgynous apertures are placed in front of the female orifice, and are closely associated together, the male being anterior. The penis (Pl. XVIII. fig. 4 *b*) is very slender and linear, much more so than in any *Doris* I have examined. The glandular tube connecting the penis with the oviduct is composed of two portions, one much stouter than the other. The delicate or outer portion (fig. 2 *c*) is connected with the root of the penis (*b*), and is much longer than the other (*d*), which, however, is of considerable length, and contains, apparently, a minute convoluted tube. This inner dilated portion has its inner extremity connected with the oviduct (*j*) just before the latter sinks into the mucous gland of the female parts. The whole of this glandular tube is closely convoluted, and lies in front of the other organs, and was described in the paper before referred to, on the anatomy of *Doris*, as the testis; but I am now satisfied, for reasons afterwards given, that this was a misnomer, and that it must be looked upon as a vas deferens.

The ovary (Pl. XVII. fig. 1 *s*), which is of a full rose-colour, is spread over the anterior surface of the liver, and is comparatively of limited extent. It is composed of a few well-marked lobes, which are made up of numerous minute lobules. Two main branches of the oviduct are seen to converge as they leave the upper and anterior surface of the ovary, and almost immediately to unite, forming a delicate tube (*t*), which, passing to the right, abruptly dilates (*u*). This dilated portion (Pl. XVIII. fig. 2 *i*) is of considerable length, and is convoluted into an irregular mass, which is of a reddish flesh-colour. The oviduct again suddenly contracts into a slender tube (*j*), and, almost immediately doubling upon itself, communicates with the inner extremity of the vas deferens, and then sinks (*k*) into the anterior portion of the great mucous gland, where, no doubt, after uniting with the tube of the androgynous apparatus, it opens into the female channel.

Originally we looked upon the ovary in the Nudibranchs as a gland merely for the purpose of secreting the ova; but further experience has proved that those naturalists are correct who have asserted that the ovary in these animals is a compound organ for the development not only of ova, but likewise of spermatozoa *. I have detected in several Nudibranchs separate sacculi or portions of the organ for the development of the ova and the spermatozoa respectively, but have not succeeded in determining these parts with sufficient precision in *Doridopsis*. It will therefore be necessary to the right comprehension of these parts, in this genus, to examine them in detail in some of the other forms just alluded to.

First, then, with regard to *Goniodoris nodosa*, the so-called ovary (Pl. XIX. fig. 1), is composed of a wide ramified tube spread over the liver. The ramifications show little disposition to symmetry, except that there is a tendency to a pinnate arrangement of the secondary branches, the whole forming a system that terminates in the oviduct (*c*), which is much constricted as it leaves the organ. All the ramifications (*d*) are thickly beset, on the under surface and extremities, with sacculi or diverticula (*e*), the ovigerous sacs, which are of a darker colour than the tubes, and are filled with ova. The ramified tubes themselves contain spermatozoa in parallel order, and apparently in an incipient state. Here, then, these tubes seem to be the male secreting organ, while the sacculi produce the ova.

The so-called ovary in *Doris tuberculata* is composed of a minute ramified tube (fig. 4 *d*), with the under surface, margins, and ends beset with comparatively large rounded sacculi (*e*) of a full yellow colour. These secrete the ova; the tubes the spermatozoa.

In *Triopa claviger*, the organ is spread over the upper surface of the liver, and is composed of numerous large, pale, oval sacculi (fig. 6 *d*), having their upper or external extremities encircled with nine or ten small rounded sacculi (*e*) of a yellow colour. These are the ovigerous sacs. The large central sacculi compose the testicular organ, and were found crammed full of spermatozoa in parallel order, and in various states of development. The connexion of the oviduct with the large sacculi was not observed; but a minute tube or duct was seen uniting them together, creeping over the surface of the organ and passing between the ovigerous sacs. The whole organ gives to the surface of the liver the appearance of a tessellated pavement, with large, pale, circular centres, surrounded by a dark yellow margin composed of numerous rounded pieces.

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* See 'Anatomy of the Invertebrata,' by Siebold, translated by Burnett, p. 257.

In *Polycera ocellata* the so-called ovary, as in the preceding species, is formed of two kinds of sacculi; but in this form they are more nearly of equal size. The testicular sacculus (fig. 5 *d*) is pyriform, with the small or inner extremity attached to a twig of the oviduct (*c*); the broad extremity is studded with a few irregularly rounded ovarian sacculi (*e*), which open into the former.

In *Bornella digitata* the appearance of the parts is very peculiar. The ovary is of a greenish colour, with dark dusky-green spots, which are formed by the rounded extremities of large pyriform vesicles (fig. 10 *d*). The tapering or inner extremities of these gradually subside into delicate tubes, which, uniting, go to form the oviduct (*c*). The large end of these sacculi is studded over with comparatively small rounded vesicles (*e*), which communicate with the former by very short constricted tubes, which, being of a black colour, are readily observed. The large pyriform vesicles were found to be filled with spermatozoa in bundles, and the small rounded ones, communicating with them, to contain eggs. The former were of a pale watery-green colour, the latter of a yellowish hue.

In *Scyllæa pelagica* the so-called ovary is made up of three globular masses, the surface of which has a granular appearance, as if covered with minute cells. On dividing one of these masses through the centre, a very beautiful structure is exposed to view. The greater portion of the mass is seen to be formed of two concentric layers, the outer (fig. 9 *e*) of which is about half the thickness of the inner (*d*), and is composed of minute cylindrical or fusiform vesicles arranged at right angles to the surface, or in a radiating manner. The outer extremities of these vesicles, which frequently bifurcate, abut upon the surface of the mass, giving to it the granular appearance before alluded to. The inner layer is composed of vesicles of a similar form to those of the outer layer, but which are very much longer, and, radiating in like manner, have their inner extremities united in pairs, and joined to delicate twigs or branchlets which converge to the oviduct (*c*) that lies in the centre of the mass and issues from it to be joined by branches from the other ovarian masses on its way to the mucous gland. The outer extremities of these vesicles are conjoined to the inner extremities of the vesicles of the outer layer. Thus the vesicles of both layers are in communication with the oviduct; and here we have a beautiful modification of the male and female sacculi, those of the inner layer bearing spermatozoa, while those of the outer produce ova.

Had I not originally mistaken the ovarian mass for a portion of the liver, I might years ago have satisfied myself of the double nature of the so-called ovary; for this well-marked structure was fully determined and figured in the 'Monograph of the British Nudibranchs'*.

The structure of the ovary in *Eolis papillosa* is very similar to that in *Scyllæa*. Each lobe of the organ represents one of the globular masses of the latter, and is penetrated by a branch of the oviduct (fig. 11 *c*), which passes up the centre of the lobe, giving off lateral branches, which, dividing and subdividing, radiate towards the circumference and communicate with the inner extremities of various systems of two or more elongated fusiform vesicles (*d*), the outer extremities of which are, for the most part, bifid, and terminate in one or more ovigerous sacculi (*e*); these, however, are not marked off by any constriction (fig. 12). The vesicles themselves, or the inner portions of them, produce spermatozoa. Thus it may almost be said that, in this form, the male and female elements are secreted by different portions of the same vesicles or sacculi.

From the above-cited examples, there can be little doubt that in the whole of the Nudibranchs the so-called ovary is a compound organ, producing both the male and female elements, each being secreted by a definite part of the organ, most frequently in distinct sacculi or vesicles, though the male vesicles occasionally assume the form of ramified tubes. Such being the case, it might safely be concluded that this organ is also compound in *Doridopsis*, even though the details had not been at all determined; enough, however, has been observed to warrant the belief, after the above examination, that the ova and spermatozoa are developed in distinct sacculi or vesicles.

The oviduct in this form ramifies, as a minute tube, throughout the so-called ovary, which is composed of a vast number of small lobules, each of which is formed by a cluster of pyriform ovigerous sacs. A delicate branch of the oviduct penetrates into the centre of each lobule, and distributes radiating twigs to the inner or small extremities of the ovigerous sacs. The twigs are considerably dilated as they reach the sacs, and form apparently the male sacculi. Thus it is sufficiently clear that the so-called ovary in *Doridopsis* is a compound organ secreting both the male and female elements, as it does in all the other Nudibranchs referred to. But neither in it nor in the latter is there the slightest indication of the invagination of the testicular sacculi within the ovarian, as is stated to be the case by Heinrich Meckel†; nor does it appear that the vas deferens is included within the oviduct, as asserted by the same authority. Indeed there can be no doubt that in the Nudibranchs, at least, the oviduct is a simple tube, and that it acts first in the capacity of a vas deferens and then as an oviduct. In the one case the spermatozoa will be conveyed by it to the glandular tube connected with the penis, which tube is the vas deferens proper; in the other case the ova will pass down the oviduct into the mucous gland, and so to the female outlet.

The enormous extent of the glandular tube or vas deferens proper is, nevertheless, very extraordinary, particularly in some of the *Dorides*, as, for instance, in *Doris tuberculata* of Verany, in which not only is the attenuated portion of great length, but the part which corresponds to the dilated division in *Doridopsis* assumes the form of a bulky gland, made up of a dense mass of convoluted tube. This enormous development can only be explained on the supposition that the tube is not a mere vas deferens after all, but is, moreover, a gland; and as it is not for the evolution of the spermatozoa, which we have seen are matured in the sacculi in connexion with the ovary, it is probably for the purpose of providing some fluid required only during the act of coitus, to be secreted in large quantity during a limited period of time. In the bulky and frequently much convoluted mucous gland in connexion with the female channel, we see another example of an organ which has to elaborate its secretion during the short time required for the deposition of the ova. Hence the great development of these parts of the organism.

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* See Fam. 2, plate 5. fig. 7 of that work.

† See Report on Zoology for 1844, published by the Ray Society.

The great mucous gland (Pl. XVIII. fig. 2*g*) appended to the female organs is a large, elongated, rounded mass, somewhat lunate or bilobed,—the whole being of a yellowish colour, and more opake than usual. The posterior lobe is seen to be composed of a convoluted tube; the structure of the anterior portion was not determined, but the surface of the whole mass is minutely granular. The female channel (*e*) passes from the right or convex side of the gland, and is a short, thick tube. It opens externally immediately behind the orifice leading into the androgynous apparatus. A small compact gland (*f*), with folliculated walls, lies on the upper surface of the channel, and opens into it close to the external orifice. This is also apparently a portion of the female organs, though it may, perhaps, be functionally connected with the common vestibule into which all the parts open.

The Androgynous Organs.—The tube (Pl. XVIII. fig. 2*l*) leading to these organs we have seen to open into the common vestibule immediately behind the male intromittent organ, and consequently between it and the orifice of the female channel. It is very slender, corresponding in size to the penis which it has to receive during coitus, and is considerably longer than the female channel, over the surface of which it takes an undulating course. The outer extremity opens into the apex of a small conical pouch; or rather the extremity may be said to enlarge a little at its termination. The other or inner extremity opens into the narrow end of a pyriform spermatheca (*m*), of a yellowish hue, which is fully one-third as large as the mucous gland. Close to the point where this androgynous organ receives the external or vaginal tube, it gives off a small duct (*n*), which shortly sinks into the mucous gland, near to the female channel, on its way to join the oviduct. Just before it disappears, it is joined by a short tube from a small, oval, rose-coloured sac or accessory spermatheca (*o*).

The reproductive organs of *Doridopsis nigra* strongly resemble those just described. The male intromittent organ, however, is still more minute; and the vas deferens, though divided into a dilated and attenuated portion, is much shorter than in the former species. The dilated portion (Pl. XVIII. fig. 3*c*) is of a pale yellow colour; and the convolutions of the minute tube within it are distinctly seen through its walls.

The ovary is of a yellow colour, and is more extensively spread over the liver than it is in *D. gemmacea*. The oviduct (*h*) is much attenuated; it is short, and passes directly from the anterior portion of the ovary to the mucous gland (*g*), placed at the right side of the body. Just as it reaches this organ, it has appended to it an elliptical sac (*i*) of considerable size, which is adherent, by the greater portion of one side, to the duct. This sac or enlargement corresponds to the dilated portion of the oviduct in the former species. The duct shortly afterwards bends suddenly upon itself, and receives a minute tube (*d*) from the inner extremity of the dilated portion of the vas deferens proper, and then, turning to the right (*k*), after a short course, dips (*l*) into the mucous gland at the point where the latter is united to the female channel.

The mucous gland (*g*) is lunate, with the convexity towards the right side of the body; it is pretty uniformly of a pale yellowish hue. The posterior portion is made up of a densely convoluted tube, which at the extremity of the organ is coarse, but very minute next the female channel. The anterior extremity is apparently strongly and irregularly laminated or folded in the interior. The female channel (*e*) is much longer than usual, and tapers towards the external outlet. It opens, apparently, into the centre of the mucous gland. The gland (*f*), in connexion with the external outlet, is considerably larger than it is in the previously described species, and its walls are more strongly folliculated.

The vagina (*m*), or tube leading from the exterior to the spermatheca, is exceedingly slender. The outer extremity, though somewhat enlarged, corresponds in size to the diminutive penis. This tube is longer than that in the former species, and so is the tube which goes from the spermatheca to the oviduct; and the latter tube is a little swelled (*q*) just before it receives the duct from the accessory spermatheca. The two spermathecæ (*n*, *p*) are nearly of a size; but in other respects they resemble those previously described. The accessory spermatheca was found crammed full with spermatozoa in bundles.

Circulatory and Respiratory Systems.—The blood-circulation and respiration appear to be much in the same condition as they are in the *Dorides*. The heart is placed far behind upon the dorsal surface of the liver, immediately beneath the skin of the back. It occupies a well-defined membranous pouch, the so-called pericardium, which is large in these animals, and is as wide as the visceral mass upon which it rests. In *D. gemmacea* the walls of this organ (Pl. XV. fig. 1 *l*) are rendered unusually opake by the colouring-matter of the peritoneum, which is of a strong brown hue, and which forms the outer layer of the pouch. On laying the latter open, the inner or lining membrane of the dorsal wall is found to be thrown into folds or plates (Pl. XVI. fig. 4 *b*), which extend from the anterior margin for some way backward. They are of a pale yellow colour, and have somewhat the appearance of being glandular.

The ventricle (*c*) is pyriform, with the apex placed forward, and has thick muscular walls. The auricle, the walls (*e*) of which are, as usual, thin and delicate, occupies the posterior half of the pericardium, and opens in front through the posterior margin of the ventricle. The orifice is guarded by two delicate semilunar valves, and the interior of the ventricle is well provided with strong carneæ columnæ. The auricle, too, is supplied with fleshy columns (*f*); but they are less numerous, and are delicate and thread-like.

The arterial system seems to be as complete as it is in *Doris*. The aorta (Pl. XV. fig. 2 *k*) issues from the anterior apex of the ventricle, and gives off immediately two large trunks, which pass backwards and go to supply the liver and ovary. A small branch is then sent to the anterior portion of the liver, which it penetrates along with the œsophagus, and seems to go to supply the stomach. The aorta then continues to stretch forward until it reaches a peculiar ductless gland (Pl. XV. figs. 1 *i* & 2 *h*) that lies a little behind the nervous centres, and which in *Doris* we have supposed to be analogous to some of the vascular glands in the Vertebrata, when it gives off other two branches, one to the right, the other to the left; that to the right passes diagonally backwards and goes to the reproductive organs at the side of the body, the other enters the blood-gland already mentioned. The aorta, still continuing to advance, distributes a branch to the posterior or enlarged portion of the proboscis, which branch also supplies a twig to the nervous collar. It then bends downwards, and sinks into the anterior portion of the foot.

The blood thus distributed to the various organs, with the exception of that sent to the liver-mass, must be supposed to extravasate, after escaping from the various arterial ramifications, into the numerous lacunary spaces amidst the tissues, and thus to find its way into the great visceral cavity. It will then pass into the skin through various apertures provided for the purpose, and, streaming through the spongy tissue of which the skin is mainly composed, will reach the great lateral sinuses or veins which terminate (Pl. XVI. fig. 4 *gg* & Pl. XVIII. fig. 5 *dd*) one at each side of the auricle.

The blood that goes to supply the liver and ovary is the only portion of the circulating fluid that reaches the specialized respiratory organs; and here, as in *Doris*, it is collected by the aid of numerous venous branches into a common hepatico-branchial trunk (Pl. XVIII. fig. 5 *e*), which passes backwards along the median dorsal line of the liver; and on reaching the point where that viscus bifurcates, it turns upwards and opens on the central line into the anterior limb of an inner venous or afferent branchial channel (*f*), which is of a lunate form, with the convexity forward, and the horns passing backwards close round each side of the anal nipple. The branchial arteries (*g*) open into this channel, and, passing up the inner surface of the branchial plumes, communicate through the leaflets with the branchial veins (*h*) which run down the opposite or outer side of the plumes. These branchial veins debouch, on the other hand, into an outer arterial or efferent branchial channel (*k*), which is likewise of a lunate form, and opens forward through the convex margin into the posterior lateral angles of the auricle by two wide, short branchio-cardiac veins (*l l*, and Pl. XVI. fig. 4 *i i*), one a little on either side of the median line.

Thus the blood that circulates in the liver-mass, and passes through the special respiratory organs, is mingled with that from the other viscera, which has been returned to the auricle) after having been only imperfectly aërated on its course through the dorsal envelope) by the two great lateral venous trunks or sinuses before described.

From the above description it is evident that the anatomy of the circulatory and respiratory organs in *Doridopsis* and *Doris* is very similar, the only discrepancies being, that while in the former there are two branchio-cardiac vessels, only one is described in the latter; and that the afferent and efferent branchial channels are lunate, instead of being circular as they are stated to be in *Doris*. I have reason, however, to believe that, when these parts are re-examined in the latter animal, these differences will be found to disappear.

Renal Organ.—This organ is composed of three parts, namely, the pyriform vesicle, the so-called pericardium, and the renal chamber proper, with its external outlet.

The pyriform vesicle in *Doridopsis gemmacea* (Pl. XV. fig. 4*k*) is larger than usual, and in some species is nearly half the size of the contracted ventricle. It lies diagonally below the posterior portion of the so-called pericardium, the broad end opening through the floor of that organ a little behind the margin of the auricle, near to the point where it receives the right pallial trunk vein. The orifice (*l*) is circular, and apparently capable of being closed by a sphincter muscle. The other or pointed extremity protrudes into a large sac or chamber, the renal chamber proper (*g*), with membranous walls, that lies on the posterior portion of the liver directly above the branchio-hepatic vein. The point is perforated (*m*); and as the under surface of the vesicle is cemented, as it were, to the floor of the chamber, the upper wall of the former overhangs the orifice, and acts as a valve to prevent the return of fluid through the vesicle into the pericardial chamber. The vesicle itself is of a pale yellow colour, and has firm muscular walls; and the interior is lined throughout with numerous longitudinal pinnate laminæ.

From the connexion of the parts, it is clear enough that the so-called pericardium is really a portion of the renal organ. The former is rather larger than usual, and the inner surface of the dorsal wall, as we have already seen, is laminated in a peculiar manner at the anterior margin. The laminæ (Pl. XVI. fig. 4 *b*), which are of an opake yellow colour, are thick and close-set at the margin, but die gradually out as they extend backwards. They have a gland-like appearance, though of a firm texture.

The renal chamber proper (Pl. XV. fig. 4 *g*) is of an irregular form, somewhat pointed in front, and widening backwards. The dorsal wall is delicate and membranous, but quite distinct; the floor, however, is confounded with the capsule of the liver-mass, and is scarcely, if at all, demonstrable. A few small openings (*i*) in the floor show that the chamber is not simple, but sends branches into the liver. The wall of the widened posterior extremity is adherent to the dorsal skin of the animal at the base of the branchial crown; and here the chamber opens externally through a puncture (*j*) situated close to the right side, and in front of the anal nipple.

The extensive vascular ramifications in the walls of the renal chamber proper in *Doris* have not been observed in *Doridopsis*; neither has the glandular lining of the organ been seen. It is only under favourable circumstances that these characters can be detected; and many specimens may be opened before one is found that exhibits them.

The renal organ does not vary much in the few species that have been examined. The pyriform vesicle (Pl. XVI. fig. 1 *l*) in *D. nigra* is large, with the sides nearly parallel and the lower extremity scarcely at all pointed. In *D. tuberculosa* it is very short, thick, and well and regularly formed, as indeed it usually is in these animals. The internal pericardial laminæ are always present; and in *D. nigra* (Pl. XVII. fig. 4 *b*) they do not die gradually out, as they do in *D. gemmacea*, but terminate abruptly behind.

Nervous System.—The nervous centres are composed of the cerebral and buccal, or, as they have been termed in *Doris*, the supra- and infra-œsophageal ganglia. The former in *D. gemmacea* are highly concentrated, forming a continuous nervous mass encircling the proboscis. It (Pl. XX. fig. 5) is lobulated, however, so that the component ganglia can be distinguished; and thus the mass is seen to be formed of the usual three pairs of ganglia—namely, the cerebroid (*a a*), the branchial (*b*), and the pedal (*c*). The two former are fused into a transversely elongated mass, which lies across the upper surface of the proboscis. The pedal form a similar but smaller mass beneath that organ.

The cerebroid compose the central portion of the upper mass, and lie one on each side of the median line, across which they are fused. Their anterior margin projects a little beyond that of the branchial ganglia, which are placed on either side, forming two rounded lateral lobes. The pedal ganglia are two oval masses, with their outer extremities fused to the under surface of the branchial, and their inner extremities united to each other across the median line below the proboscis, thus completing the nervous collar around the base of that organ. The branchial ganglia are likewise united below the proboscis by a slender commissural cord (*j*), the ends of which are united to the lateral portions of the ganglia. At the attachment of the right extremity there is a minute rounded ganglion (*k*), apparently the homologue of the visceral in *Doris*. This commissure corresponds to the third cord of the sub-œsophageal collar of that form.

The cerebroid have attached to the upper surface of the anterior margin, next the median line, a pair of well-developed, rounded, sessile ganglia, the olfactory (*d*), each of which gives a large nerve (*e*) to the dorsal tentacles. Three other pairs of nerves (*f*) come off from the under surface of the anterior border of the same ganglia external to the olfactory, and go to supply the anterior part of the oral apparatus. There are no optic ganglia or nerves, the eyes (*p*) being sessile on the upper surface of the cerebroids at the external margins of the olfactory ganglia.

The branchial ganglia give off each from the upper surface towards the lateral margin three pairs of large nerves (*g*), all of which are distributed to the mantle. Two other pairs (*h*) come off at the junction of the branchial with the pedal ganglia, and go, apparently, to the external envelope at the sides of the body, though these were not satisfactorily traced to their destination. From the outer posterior margin of the pedal ganglia issue three stout nerves (*i*), all of which go to supply the foot.

The buccal ganglia (*m* and fig. 2*e*), or the infra-œsophageal, are a pair of small pyriform bodies placed close together on the under surface of the œsophagus or crop, immediately in front of and between the rudimentary salivary glands, consequently at the posterior extremity of the enlarged portion of the proboscis, which we have seen corresponds to the buccal organ of *Doris*. These ganglia are united to each other by a very short commissure, and to the under side of the cerebroids by two exceedingly long commissural cords (fig. 5*l*), which pass from the pointed extremities of the ganglia. The great length of these cords is necessitated by the action of the proboscis. From the broad or opposite extremity of each ganglia a nerve (*n*) is given off, which is applied to the surface of the œsophagus or crop, and has been traced as far as the point where the latter enters the liver-mass. This pair of nerves is equivalent to that which we have named in *Doris* the gastro-œsophageal or par vagum. Here, however, it will be observed that there are no gastro-œsophageal ganglia, but that the nerves come off directly from the buccal ganglia.

These nerves and their ganglia, together with the minute visceral ganglion in connexion with the right branchial, are the only indications of a splanchnic system that have been observed, though there is no reason to suppose that this portion of the nervous apparatus is less perfect than it is in *Doris*. It is only under very favourable circumstances that the sympathetic ganglia and the numerous delicate nervous plexuses in connexion with them can be fully traced. A great number of specimens may be examined before this can be done satisfactorily; therefore my not having observed them in the comparatively few individuals that have been dissected of *Doridopsis* is not at all to be wondered at, especially as I have made no determined search for them.

The cerebral ganglia exhibit in a remarkable manner the globular structure usually observed in the brain of the Nudibranchs. In *D. gemmacea* the cerebroid and branchial ganglia are entirely composed of numerous irregular rounded nodules, which give to the surface of these organs a very striking appearance. In *D. nigra* the cerebroid ganglia (fig. 6) are each broken up into four or five pretty regularly formed and symmetrically arranged masses, while the branchial are more minutely divided into globules.

The Organs of the Senses.—If the sense of smell resides in the dorsal tentacles (and there seems little reason to doubt the fact), it is apparently as well developed as it is in *Doris*. The tentacles have the upper portion laminated or pinnate, in the same manner as it is in that genus; and the olfactory ganglia are quite as large.

The eyes are sessile on the anterior margin of the cerebroid ganglia, close to the outer margin of the olfactory ganglia. They lie consequently beneath the skin, and therefore cannot be very efficient organs of vision. They are, nevertheless, well developed, though minute. The black-pigment cup is deep and well formed, and has lying within it mouth a globular crystalline lens, before which is placed an arched transparent cornea.

There are no organs in these animals to which the sense of taste can be assigned, unless it be supposed to reside in the proboscis; and that it does so seems not at all unlikely. It can scarcely be doubted that these animals enjoy the advantage of this sense; and as they possess neither tongue nor lips, nor any other surface that comes in contact with the food but that of the proboscis, it follows as a matter of course that this suctorial tube must be the seat of taste, if it exists at all in these animals; and if it is to be of any service to them in testing the quality of their food, it must reside at the anterior extremity of the organ; at least it would be most conveniently situated there.

If we adopt these conclusions as probable, this proboscidiform mouth may throw some light on the question as to the seat of taste in the other Nudibranchiate Mollusca. Here we have an animal without a tongue or outer lips, and in which taste, if it exists, must be located in the proboscis, and most probably at its anterior extremity. Thus the question becomes simplified; and what we have to do is to determine, if possible, what part of the oral apparatus in *Doris*, for instance, corresponds homologically to the extremity of the proboscis. First of all, if we examine carefully the anterior termination of this organ, there is observed a slight transverse ridge (Pl. XVII. figs. 2 *l* & 3 *a*) a little way within the orifice, immediately behind the opening of the duct of the anterior salivary (?) glands, the margin (*f*) of the orifice of the proboscis being slightly thickened.

Now, if we turn to the oral apparatus in *Doris tuberculata*, we find that directly in front of the anterior extremity of the buccal organ there projects into the channel of the mouth a transverse fleshy lamina, the inner lip; and in advance of this the oral channel terminates in the outer lip. It would seem that the ridge within the termination of the proboscis represents the anterior extremity of the buccal organ or buccal lip in *Doris*, and that the thickened margin surrounding the orifice of the proboscis is the homologue of the inner lip, the channel of the mouth in front of this point being enlarged and developed into the sheath or sac of the proboscis. The margin of the external opening (*e*) in the sheath corresponds to the outer lip in *Doris*. If, then, we are correct in assigning the function of taste to the anterior extremity of the proboscis, it may be fair to assume that it resides in the inner lip of *Doris*, a part which has already been pointed out as the probable seat of this sense*. This, of course, is not conclusive; for it may have happened that the function of the parts has changed. It is, however, satisfactory to be able to observe that in *Eolis*, a genus which is provided with cutting jaws, there is likewise a similar inner lip.

Touch is probably specialized in the small tentacular points at the sides of the head. As these are exceedingly short, they can only be serviceable in ascertaining the quality of the surface of bodies over which the animal is moving, and thus to assist it in the selection of its food.

The auditory capsules were not observed, though there is no reason to doubt their existence.

Having now completed our examination of the anatomy of *Doridopsis*, organ by organ, it is quite clear that, with one exception, the internal structure agrees with the external conformation in showing the close relation of these animals to *Doris*. Indeed there is no internal or external character, with the above remarkable exception, that would induce the systematist to separate generically these two forms, unless the deficiency of spicula in the skin or the peculiar character of the head and position of the external oral opening should be thought sufficient. No one could have surmised that, in an animal with all the other parts arranged so completely on the type of *Doris*, the powerful muscular buccal organ, with the spiny prehensile tongue of that genus, should be turned into a delicate suctorial proboscis; nor, after having witnessed this fact, is it easy to comprehend how such an important change in the alimentary system should not have drawn along with it some necessary and extensive modification of the other structures in the general economy of the animal.

Surely the mode of sustentation in *Doridopsis* is very different from that of any other Nudibranch. It is true that in both *Melibe* and *Tethys* the tongue is equally deficient; nor is there any spiny prehensile organ of any sort, or jaws, the oral apparatus being reduced, as it were, in these two genera to a mere enlargement of the anterior extremity of the œsophagus, guarded in front by fleshy lips. The change in these cases is restricted almost entirely to the suppression of the lingual organ. But in *Doridopsis*, in addition to the atrophy of the tongue, the buccal bulb is itself modified, as we have seen, into a delicate suctorial proboscis. This modification is so remarkable, that, taken in conjunction with the deficiency of spicula in the mantle, we have thought it sufficient to justify us in establishing a new family for the reception of all the *Doris*-like animals so characterized. Thus *Doridopsidæ* now makes the third family in the suborder *Acanthobranchiata*.

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* Phil. Trans. 1852, p. 243.

EXPLANATION OF THE PLATES.

PLATE XV.

Fig. 1. Dorsal view of the viscera, undisturbed, of *Doridopsis gemmacea*: *a*, dorsal skin of the animal, turned back; *b*, peritoneum laid open and reflected; *c*, circular apertures in ditto; *d*, anterior portion of the proboscis; *e*, posterior or enlarged portion of ditto; *f*, œsophagus or anterior stomach; *g*, liver; *h*, intestine; *i*, ductless gland, in connexion with the blood-system, overlying anterior portion of the reproductive organs; *j*, portion of the reproductive organs; *k*, ovary; *l*, dorsal wall of the so-called pericardium; *m*, cerebral ganglia, giving off nerves to the various organs.

Fig. 2. Dorsal view of the undisturbed viscera of *D. nigra*, seen through the transparent peritoneum: *a a*, dorsal skin laid open and turned back; *b*, anterior portion of the proboscis; *c*, crop or anterior stomach; *d*, liver; *e e*, reproductive organs; *f*, female channel; *g*, gland in connexion with ditto; *h*, ductless gland in connexion with the blood-system; *i*, the so-called pericardium; *j*, ventricle, seen through the wall of ditto; *k*, aorta; *l*, cerebral ganglia, giving off various nerves; *m*, intestine.

Fig. 3. View of the anterior portion of the foot and head of *D. nigra*: *a*, mantle; *b*, foot; *c*, thickened anterior border of ditto; *d*, smooth area of ditto; *e*, head, with lateral tentacular points; *f*, oral orifice.

Fig. 4. View of the renal chamber proper, the dorsal wall laid open, of *D. gemmacea*: *a a*, liver; *b*, intestine; *c*, anal nipple; *d*, ventricle of heart, turned forward; *e e*, portions of the wall of the so-called pericardium; *f f*, dorsal skin of animal; *g g*, renal chamber proper; *h h*, dorsal wall of ditto, turned back; *i i*, apertures of branches of the renal chamber, penetrating the liver; *j*, external orifice of the renal chamber, with a needle passed through it; *k*, pyriform vesicle; *l*, orifice of ditto, leading into the so-called pericardium; *m*, orifice of ditto, leading into the renal chamber; *n*, portion of the pericardial floor attached to the vesicle; *o*, branchial plumes; *p*, efferent branchial channel, cut through; *q*, nerve.

PLATE XVI.

Fig. 1. General view of the viscera of *D. nigra*, the digestive system turned a little to the left side: *a*, anterior portion of the proboscis; *b*, posterior or enlarged portion of ditto; *c*, salivary glands; *d*, a pair of glands, opening into the anterior extremity of the proboscis; *e*, œsophagus or anterior stomach; *f*, liver; *g*, intestine; *h h*, mucous gland of the female reproductive organs; *i*, glandular tube, leading to the penis—the vas deferens; *j j*, spermathecæ; *k*, oviduct, cut through; *l*, pyriform vesicle connected with the renal organ; *m*, a shred of the pericardial floor attached to ditto; *n*, ventricle of the heart, turned to one side; *o*, portion of the floor of the so-called pericardium; *p*, portion of the auricle; *q*, cerebral ganglia, distributing nerves to the various organs; *r*, olfactory nerve; *s s s*, aorta, cut through; *t*, ductless gland connected with the vascular system; *u*, branchial plumes; *v v*, dorsal skin of the animal, turned back.

Fig. 2. View of the stomach, laid open, of *D. gemmacea*, showing the reticulated character of its walls: *a*, liver; *b*, posterior lobes of ditto; *c*, ovary; *d*, œsophagus or anterior stomach; *e*, intestine, laid open; *f*, large fold of the mucous membrane of ditto; *g*, cavities or cells in the wall of the stomach.

Fig. 3. View of the anterior portion of the alimentary tube of *D. gemmacea*: *a*, portion of the peritoneal membrane; *b*, ductless gland connected with the blood-system; *c*, anterior portion of the aorta, giving a branch to the enlarged division of the proboscis; *d d*, two glands opening into the anterior extremity of the proboscis; *e*, cerebral ganglia; *f f*, nerves given off from ditto; *g*, one of the buccal ganglia; *h*, commissure connecting ditto with the cerebroid ganglia; *i*, one of the œsophageal nerves; *j*, posterior wall of the sac or sheath of the proboscis; *k k k*, retractor muscles of ditto; *l*, anterior portion of the proboscis; *m*, posterior or enlarged portion of ditto; *n*, œsophagus or anterior stomach; *o*, salivary gland.

Fig. 4. The so-called pericardium of *D. gemmacea*, laid open, showing the ventricle and auricle, the latter likewise laid open: *a a*, dorsal wall of the pericardium, turned back; *b*, laminæ at the anterior margin of ditto; *c*, ventricle; *d*, auriculo-ventricular orifice; *e e*, wall of the auricle, laid back; *f*, fleshy columns of ditto; *g g*, openings of the great lateral pallial trunk vein or sinus; *h*, small orifices leading apparently into the skin; *i i*, branchio-cardiac channels, leading from the efferent branchial channel; *j*, efferent branchial channel; *k k*, openings of the lateral portions of ditto; *l*, orifices of the branchial veins; *m*, pyriform vesicle, bulging through the floor of the so-called pericardium; *n*, orifice of ditto, opening into the pericardium; *o*, branchial plumes.

PLATE XVII.

Fig. 1. View of the alimentary system of *D. gemmacea*, the other viscera having been removed: *a*, anterior extremity of the animal; *b*, branchial plumes; *c c*, dorsal skin; *d*, posterior wall of the sac or sheath of the proboscis; *e e*, retractor muscles of ditto; *f*, minute muscular bands to regulate the movements of ditto; *g*, anterior portion of the proboscis; *h*, posterior or enlarged portion of ditto; *i*, one of the salivary glands; *j*, two glands opening into the anterior extremity of the proboscis; *k*, duct of ditto; *l*, œsophagus or anterior stomach; *m*, liver; *n*, posterior lobes of ditto; *o*, intestine; *p*, anal nipple; *q*, renal orifice; *r*, pyriform vesicle in connexion with the renal organ; *s*, ovary; *t*, oviduct; *u*, enlargement of ditto; *v v*, hepatico-branchial vein, laid open; *w*, branch from aorta; *x*, one of the buccal ganglia; *y*, one of the œsophageal nerves; *z*, external opening of the reproductive organs.

Fig. 2. Anterior portion of the alimentary tube of *D. gemmacea*, laid open: *a*, portion of the anterior skin of the animal; *b*, sac or sheath of the proboscis; *c*, posterior wall of ditto, partially invaginated; *d d*, two of the retractor muscles of ditto; *e*, oral opening; *f*, orifice of the proboscis, with the margin thickened; *g*, anterior portion of the proboscis; *h*, posterior or enlarged portion of ditto, exhibiting three or four longitudinal areas in the inner surface, continuous with similar areas of the anterior portion; *i*, two glands opening into the anterior extremity of the proboscis; *j*, duct of ditto; *k*, enlargement of the duct; *l*, orifice of ditto; *l'*, ridges immediately in front of the orifice; *m*, œsophagus or anterior stomach, exhibiting the corrugations of the inner surface; *n n*, salivary glands.

Fig. 3. Anterior extremity of the proboscis, showing the continuation of the duct of the two glands through its wall: *a*, thickened margin of the orifice of the proboscis; *b b*, ridge, the homologue of the buccal lip in *Doris*; *c*, duct; *d*, orifice of ditto, leading into the proboscis.

Fig. 4. The so-called pericardium of *D. nigra*, laid open: *a a*, dorsal wall of the pericardium; *b*, laminæ at the anterior margin of ditto; *c c*, liver, seen through the floor of ditto; *d*, intestine, ditto ditto;

e, ventricle; *f*, auricle; *g*, one of the great lateral pallial veins; *h h*, branchio-cardiac channels; *i*, pyriform vesicle, seen through the floor of the pericardium; *j*, orifice of ditto, leading into the pericardium.

PLATE XVIII.

Fig. 1. Anterior portion of the alimentary tube of *D. gemmacea*, with the sac or sheath of the proboscis laid open: *a*, anterior margin of the animal; *b*, sac or sheath of the proboscis, with the dorsal wall removed; *c*, oral orifice; *d*, anterior extremity of the proboscis; *e*, orifice of ditto; *f*, posterior wall of the sheath; *g g*, retractor muscles of ditto; *h*, delicate muscular bands to regulate the movements of the proboscis; *i*, anterior portion of the proboscis; *j*, posterior or enlarged portion of ditto; *k*, two glands, opening into the anterior extremity of ditto; *l*, duct of the glands; *m*, enlargement of ditto.

Fig. 2. Reproductive organs, with the parts spread out: *a*, internal margin of the general external orifice; *b*, retracted penis; *c*, attenuated or outer portion of the vas deferens; *d*, enlarged or inner portion of ditto; *e*, female channel; *f*, small gland in connexion with ditto; *g*, mucous gland; *h*, oviduct; *i*, enlarged portion of ditto; *j*, constricted portion, communicating with the vas deferens; *k*, continuation of the oviduct, sinking into the mucous gland; *l*, vaginal channel, leading to the spermatheca; *m*, spermatheca; *n*, tube connecting ditto with accessory spermatheca; *o*, accessory spermatheca; *p*, tube from ditto, penetrating the mucous gland.

Fig. 3. Reproductive organs of *D. nigra*: *a*, retracted penis; *b*, attenuated or outer portion of vas deferens; *c*, enlarged or inner portion of ditto; *d*, constricted tube, connecting ditto with the oviduct; *e*, female channel; *f*, small gland in connexion with ditto; *g g*, mucous gland; *h*, oviduct; *i*, enlargement of ditto; *j*, constricted portion of ditto; *k*, continuation of ditto after its union with the vas deferens; *l*, extremity of ditto, sinking into the mucous gland; *m*, vaginal tube; *n*, spermatheca; *o*, tube connecting ditto with accessory spermatheca, *p*; *q*, enlargement of this tube; *r*, tube from accessory spermatheca, sinking into mucous gland.

Fig. 4. Male and androgynous apertures of *D. gemmacea*, exposed to view: *a*, vas deferens; *b*, male aperture; *c*, extremity of penis; *d*, vaginal tube; *e*, orifice leading into ditto.

Fig. 5. Diagram of the branchial circulation: *a*, ventricle of the heart, dilated; *b*, auricle of ditto; *c*, root of the aorta; *d d*, great lateral pallial veins; *e*, hepatico-branchial vein, passing below the heart; *f*, afferent branchial channel; *g g g*, branchial arteries, running up the inner or upper surface of the plumes; *h h*, branchial veins, running down the outer or under surface of ditto; *i*, artery and vein of a branchial leaflet; *k*, efferent branchial channel; *l l*, branchio-cardiac channels; *m*, anal nipple.

PLATE XIX.

Fig. 1. Ovary of *Goniodoris nodosa*: *a*, liver; *b*, œsophagus; *c*, oviduct; *d d*, male ramifications or sacculi; *e e*, female sacculi.

Figs. 2 & 3. Under and upper views of terminal lobes of the same ovary, more highly magnified: *d*, male ramifications or sacculi; *e e*, female sacculi.

(The letters of these figures, as far as they are applicable, indicate the same parts in all the figures of this plate.)

Fig. 4. An ultimate lobule of the ovary of *Doris tuberculata*.

Fig. 5. Three ultimate lobules of the ovary of *Polycera ocellata*.

Fig. 6. A portion of the upper surface of the ovary of *Triopa claviger*, considerably magnified.

Fig. 7. A portion of the under surface of the same ovary.

Fig. 8. Side view of ditto.

Fig. 9. An ovarian mass or lobule of *Scyllæa pelagica,* cut through the centre, to show the internal structure.

Fig. 10. Ultimate lobule of the ovary of *Bornella digitata.*

Fig. 11. Ovarian lobule of *Eolis papillosa,* seen in section.

Fig. 12. A few of the sacculi of ditto, more highly magnified.

PLATE XX.

Fig. 1. Anterior portion of the proboscis of *D. nigra* laid open: *a,* thickened margin of the proboscis; *b, c,* anterior and posterior portions of ditto, showing the three longitudinal areas of the interior; *d,* œsophagus or anterior stomach; *e,* corrugations of the internal surface of ditto; *f f,* salivary glands; *g,* two glands opening into the extremity of the proboscis; *h,* duct of ditto; *i,* orifice of duct.

Fig. 2. Anterior portion of the alimentary tube, turned forward, so as to show its under surface: *a,* anterior portion of the proboscis; *b,* posterior portion of ditto; *c,* œsophagus or anterior stomach; *d,* salivary glands; *e,* buccal ganglia; *f f,* œsophageal or par vagum nerves; *g,* two glands opening into the anterior extremity of the proboscis; *h,* duct of ditto; *i,* anterior extremity of aorta.

Fig. 3. View of the anterior portion of the foot and head of *D. gemmacea*: *a,* pallial margin; *b,* foot; *c,* thickened anterior margin of ditto; *d,* smooth area immediately behind the margin; *e,* head, with lateral tentacular points; *f,* oral aperture.

Fig. 4. View of the anterior portion of the foot and head of *D. rubra*: *a,* foot; *b,* thickened anterior margin of ditto; *c,* smooth area of ditto; *d,* lobes at the sides of the head; *e,* oral aperture.

Fig. 5. Dorsal view of the cerebral ganglia of *D. gemmacea*: *a a,* cerebroid ganglia; *b b,* branchial ditto; *c,* pedal ditto; *d,* olfactory ditto; *e,* olfactory nerves; *f f,* three nerves distributed to the anterior part of the oral apparatus; *g g,* pallial nerves; *h,* nerves supplying the skin at the sides of the body; *i,* pedal nerves; *j,* commissure uniting the branchial ganglia; *k,* a minute ganglion, apparently the homologue of the visceral in *Doris*; *l,* commissure connecting the buccal to the cerebroid ganglia; *m,* buccal ganglia; *n,* œsophageal nerves; *p,* eyes.

Fig. 6. Cerebral ganglia of *D. nigra*: *a,* cerebroid; *b,* branchial; *c,* pedal; *d,* olfactory; *e,* olfactory nerves; *f,* nerves supplying the anterior part of the oral apparatus; *g,* pallial nerves; *h,* pedal ditto; *i,* commissure uniting the pedal ganglia; *j,* ditto uniting the branchial; *k,* ditto uniting the buccal to the cerebroids; *l,* eyes.

Fig. 7. View of the under surface of the same ganglia, the collar having been opened, and the pedal ganglia turned to one side: *a,* cerebroid; *b,* branchial; *c,* pedal; *d,* commissure uniting the cerebroid across the median line; *e,* ditto uniting ditto to the branchial; *f,* ditto uniting ditto to the pedal; *g,* ditto uniting the branchial to the pedal; *h,* ditto uniting the pedal below the proboscis; *i,* ditto uniting the branchial; *j j,* ditto uniting the buccal to the cerebroid.

Fig. 8. Eye of *D. gemmacea,* much enlarged: *a,* black-pigment cup; *b,* lens; *c,* cornea.

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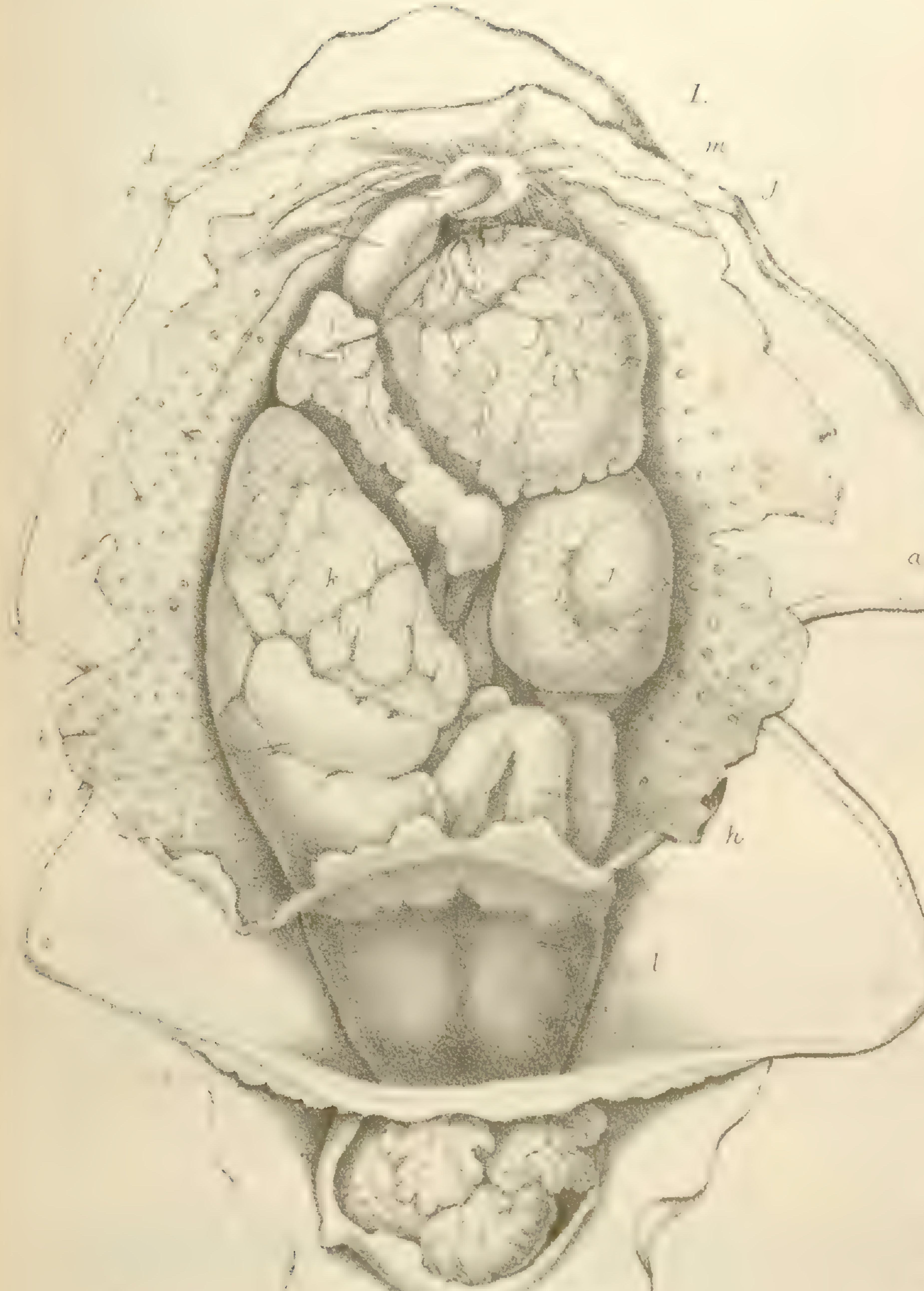

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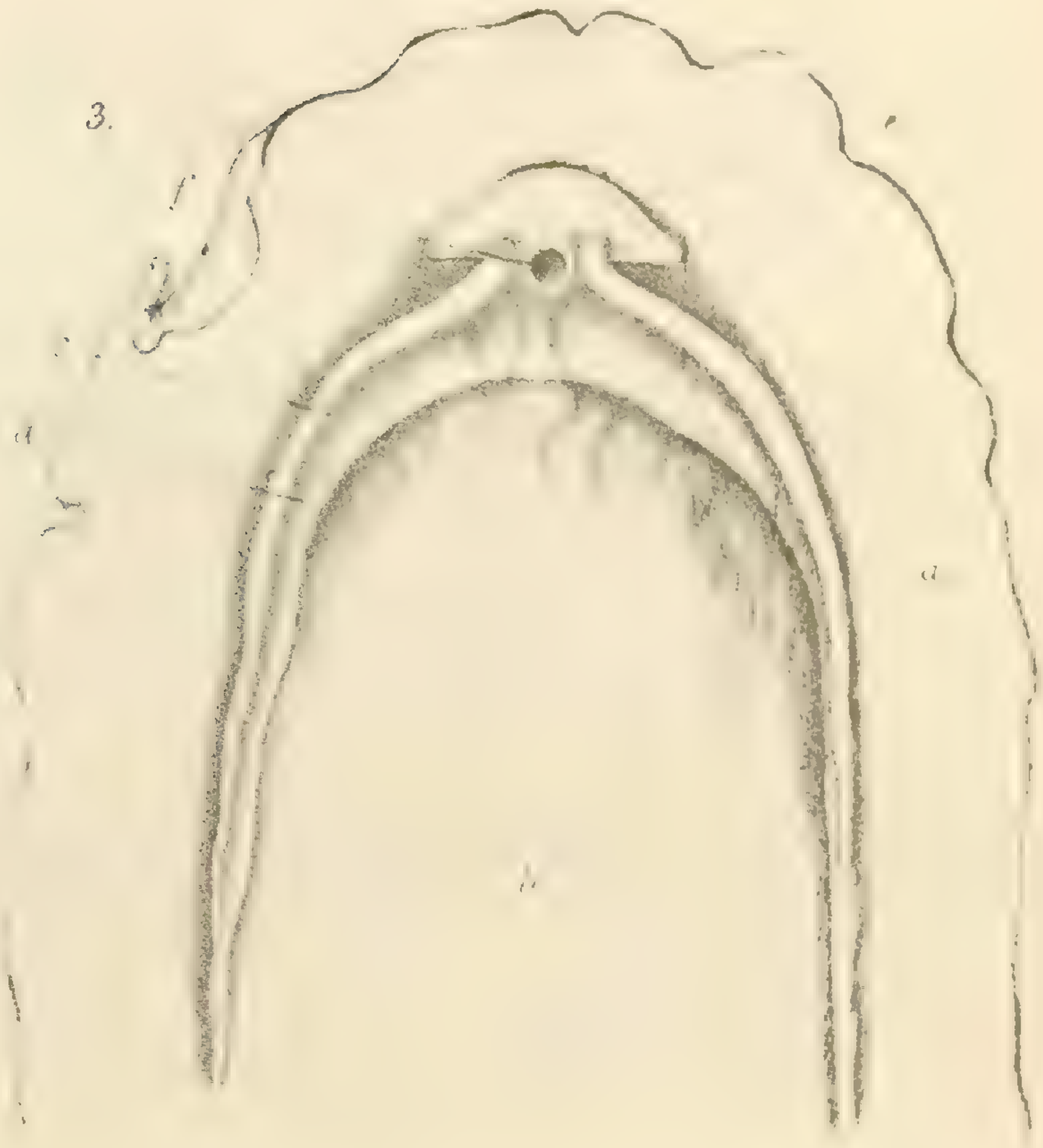

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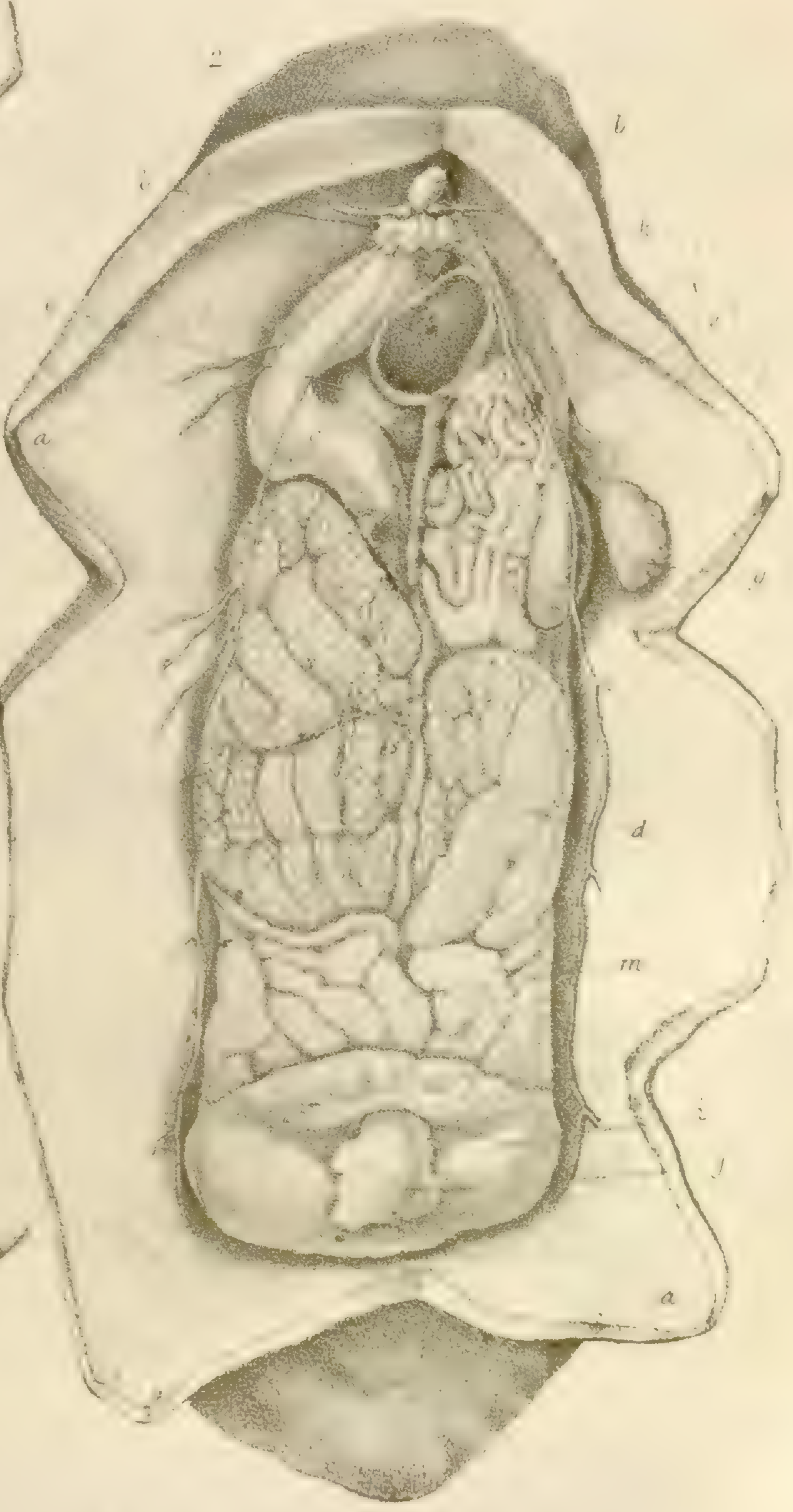

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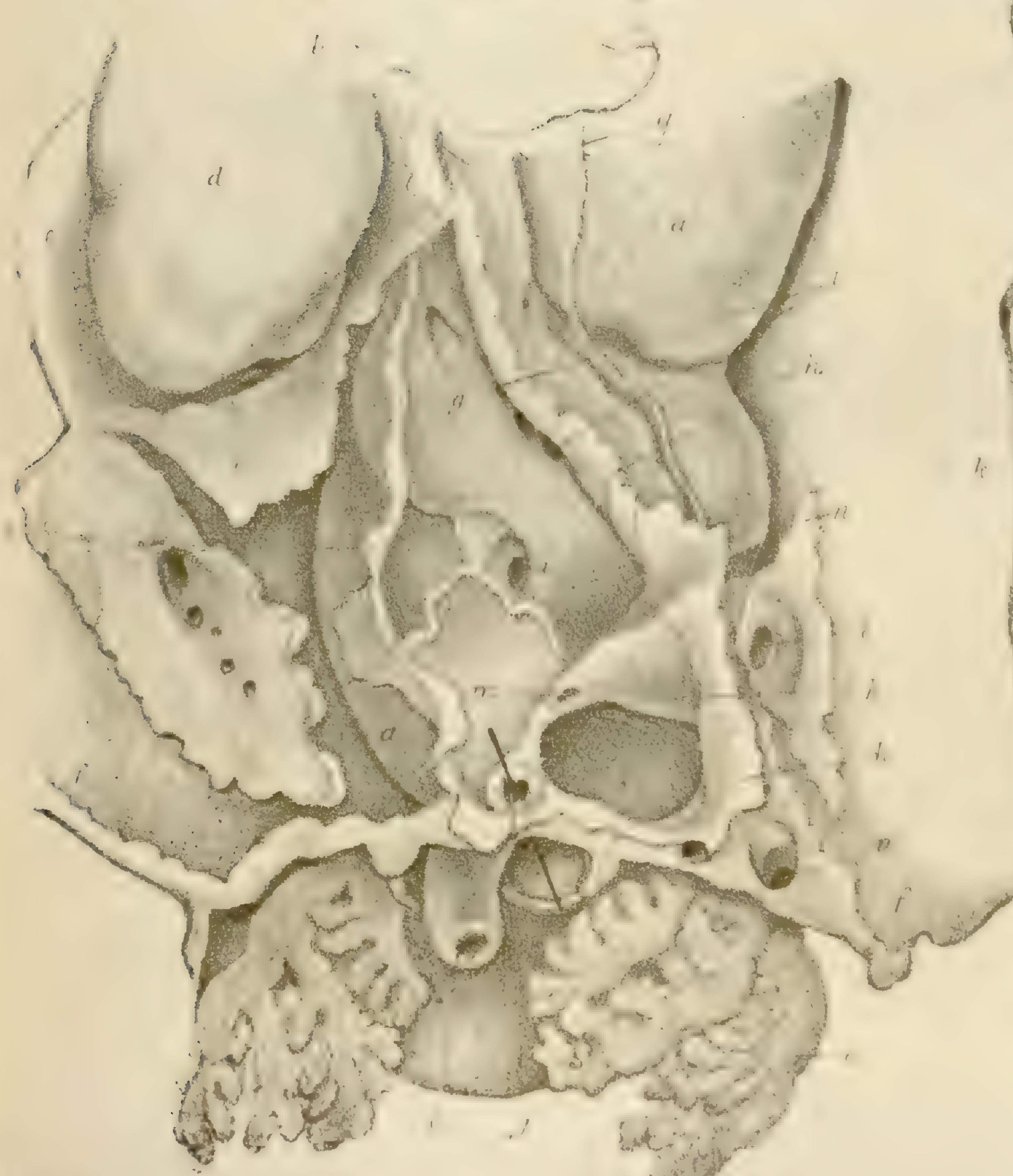

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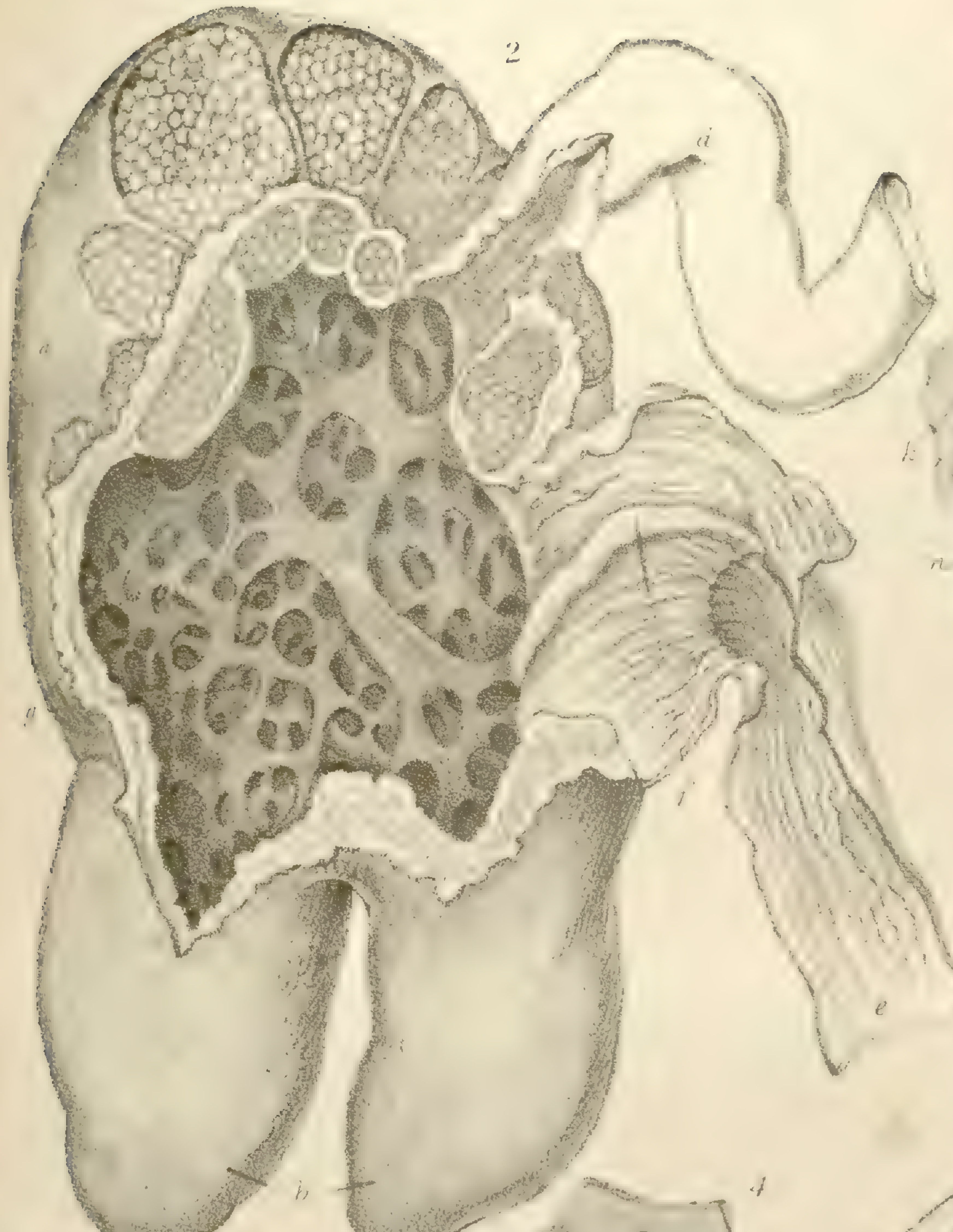

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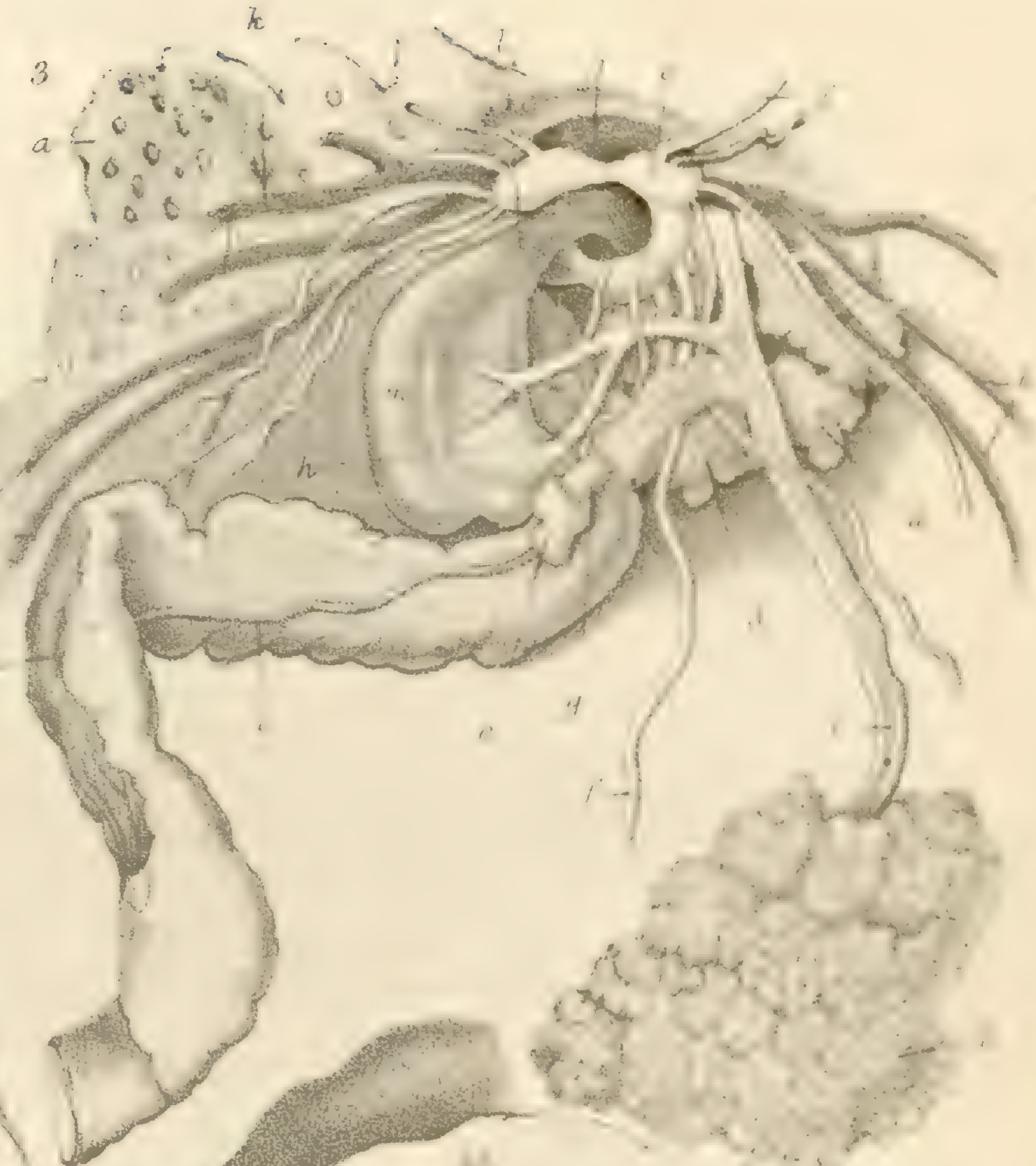

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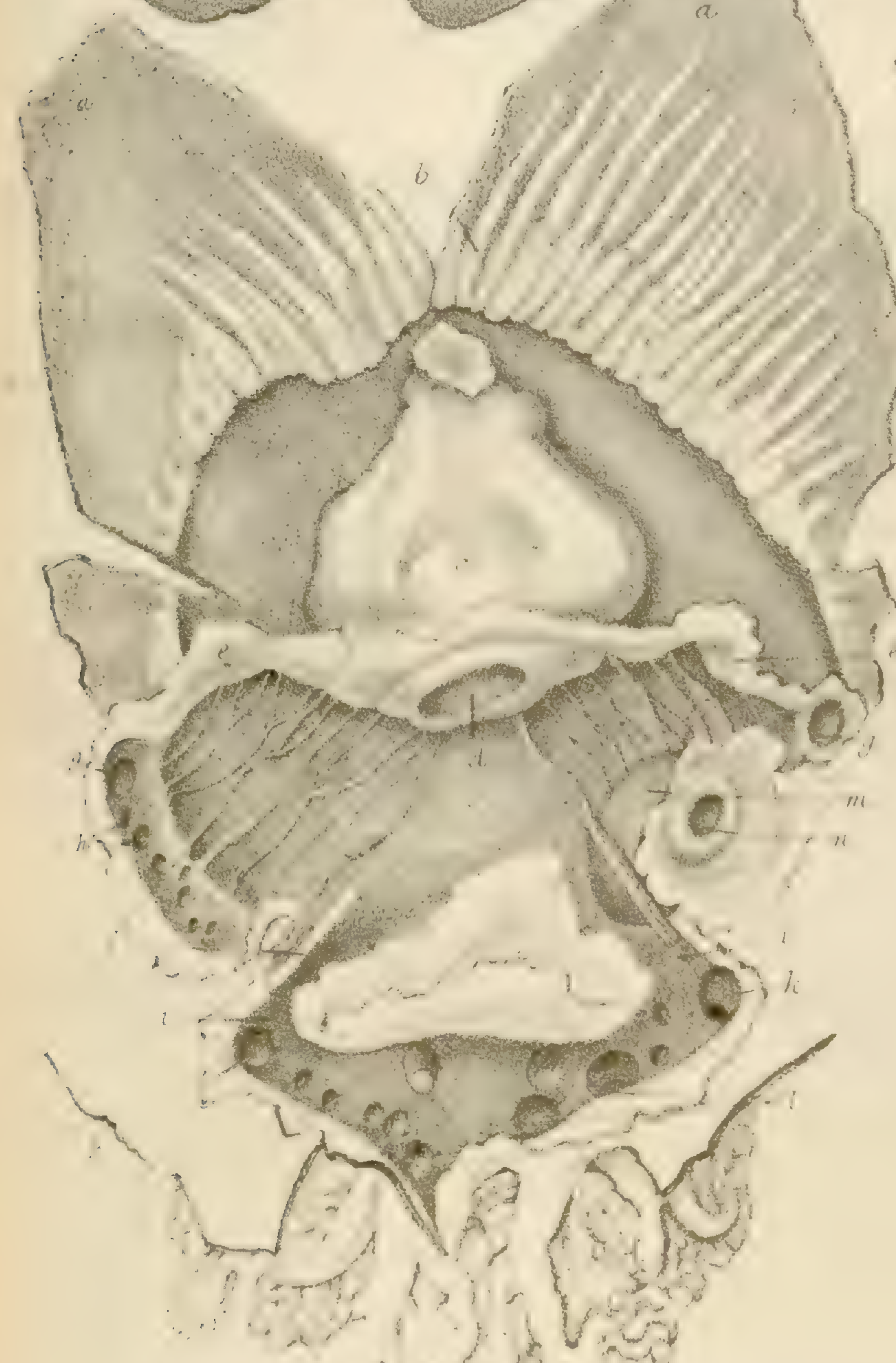
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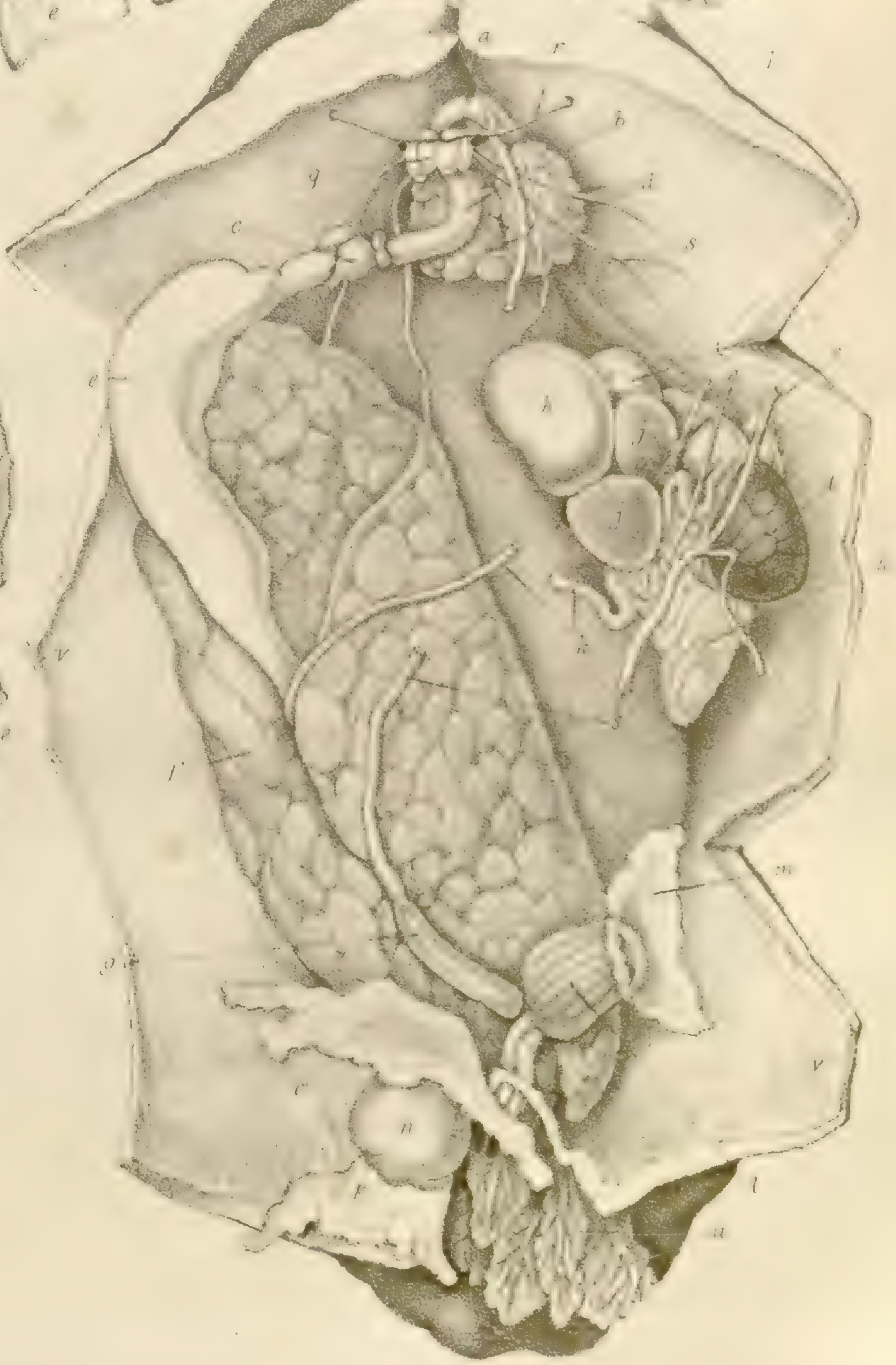
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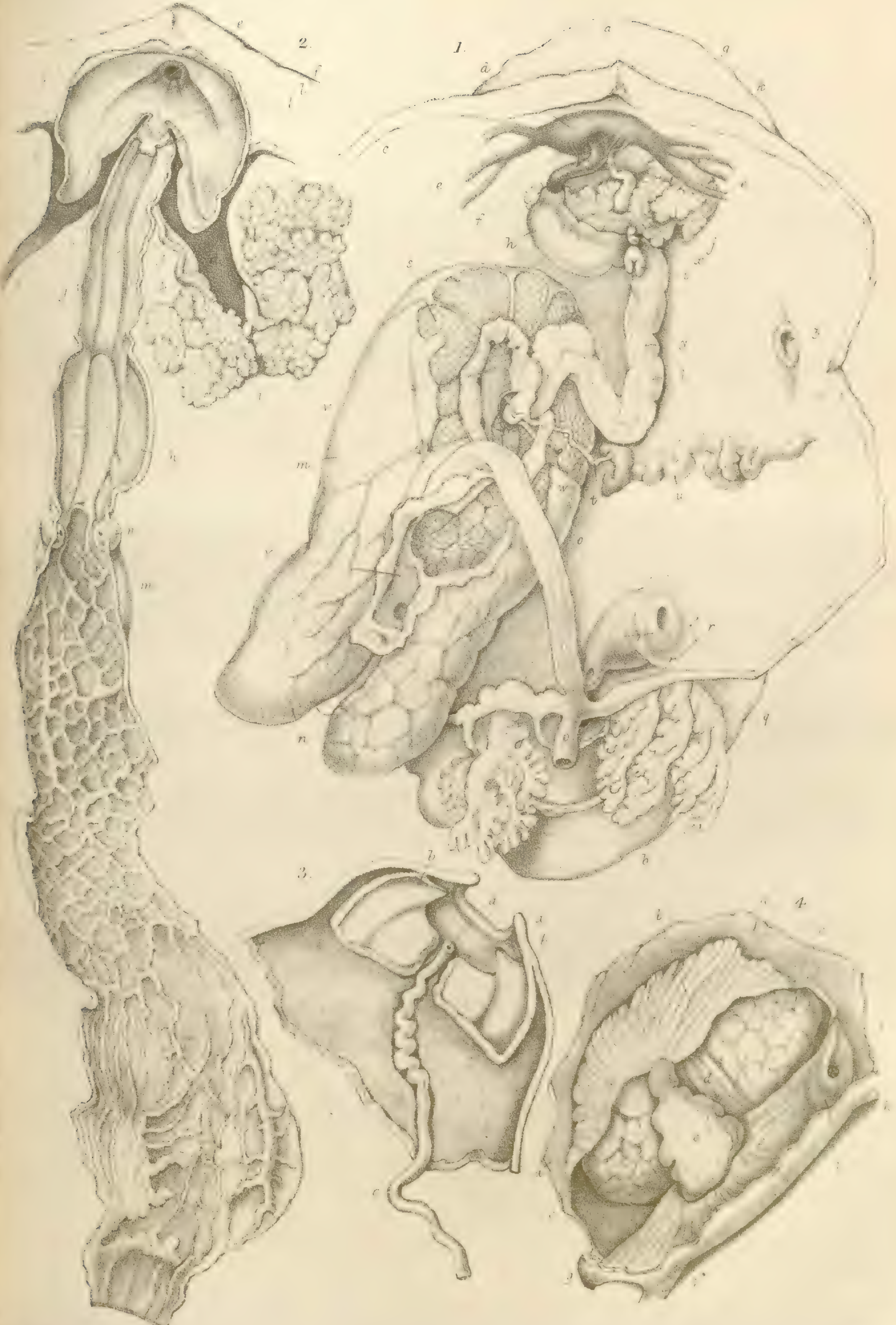
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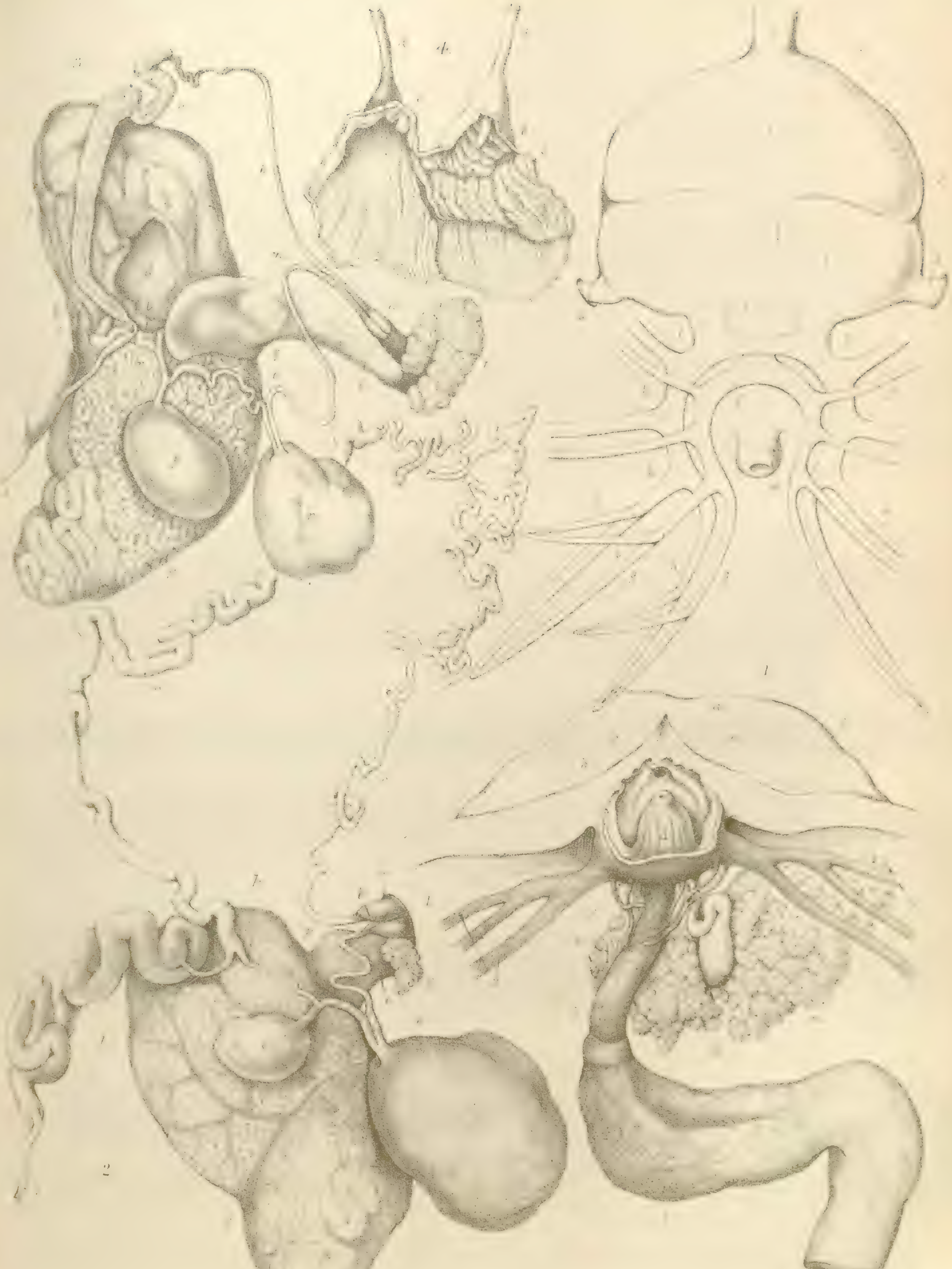

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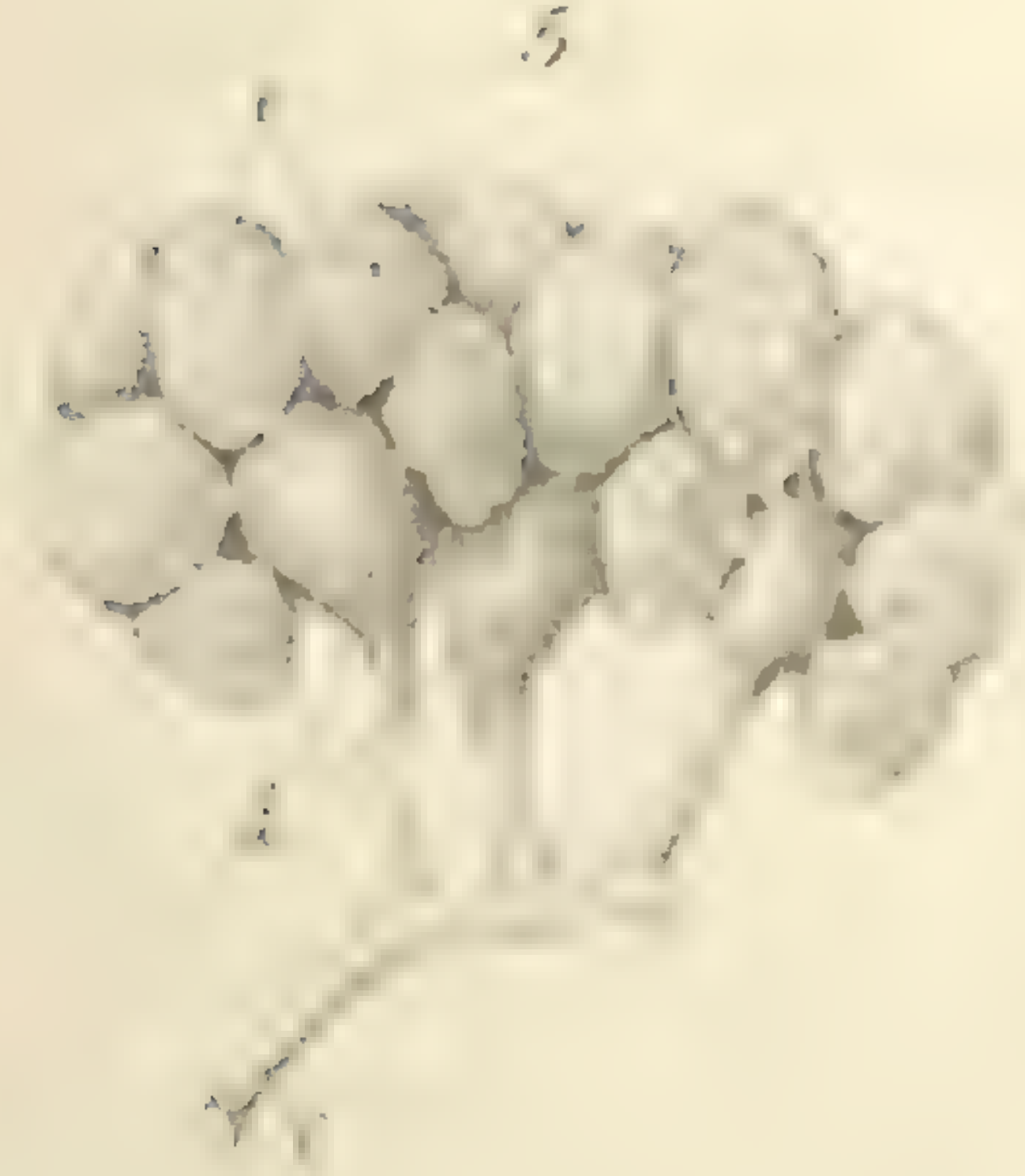

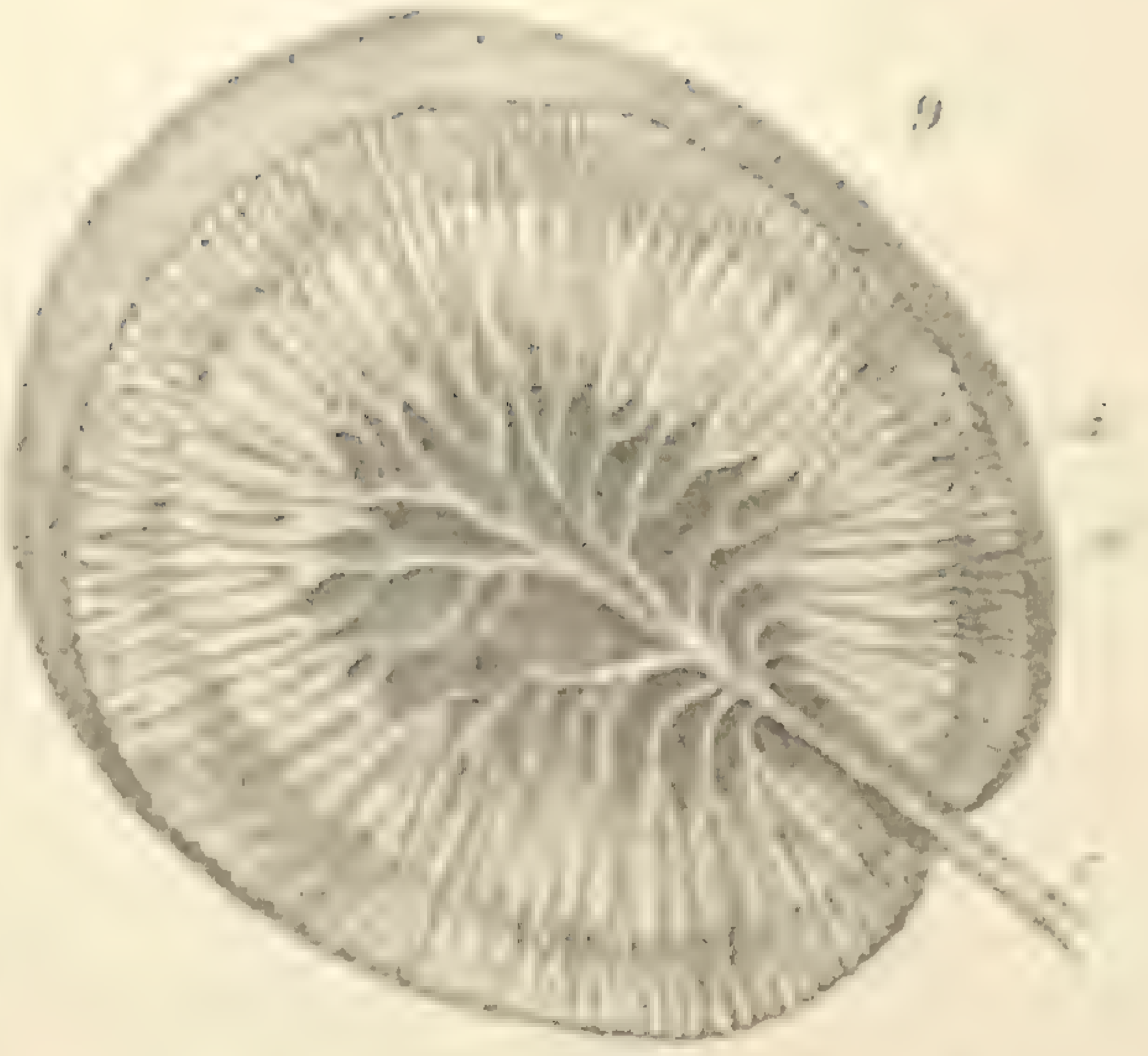

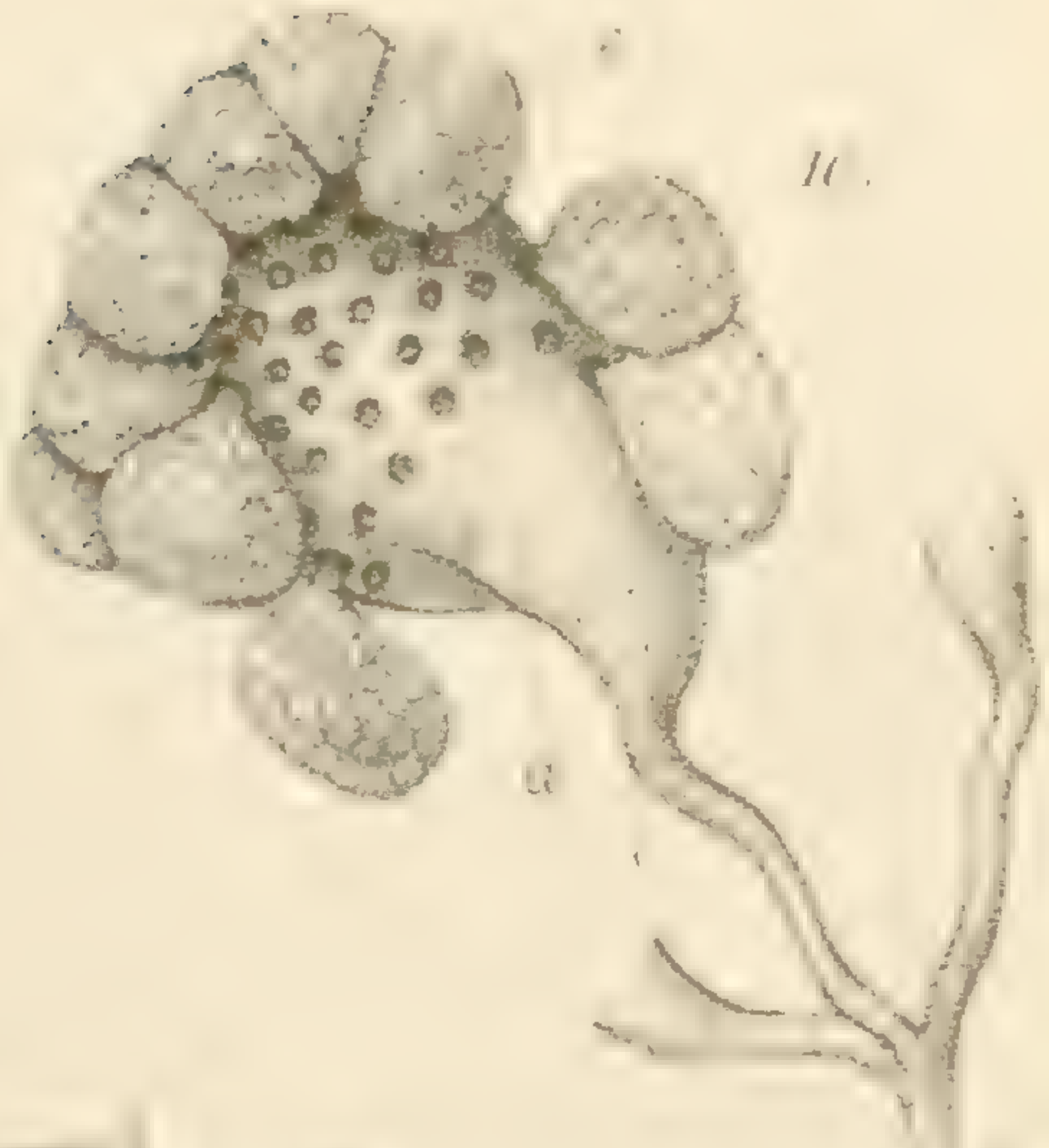

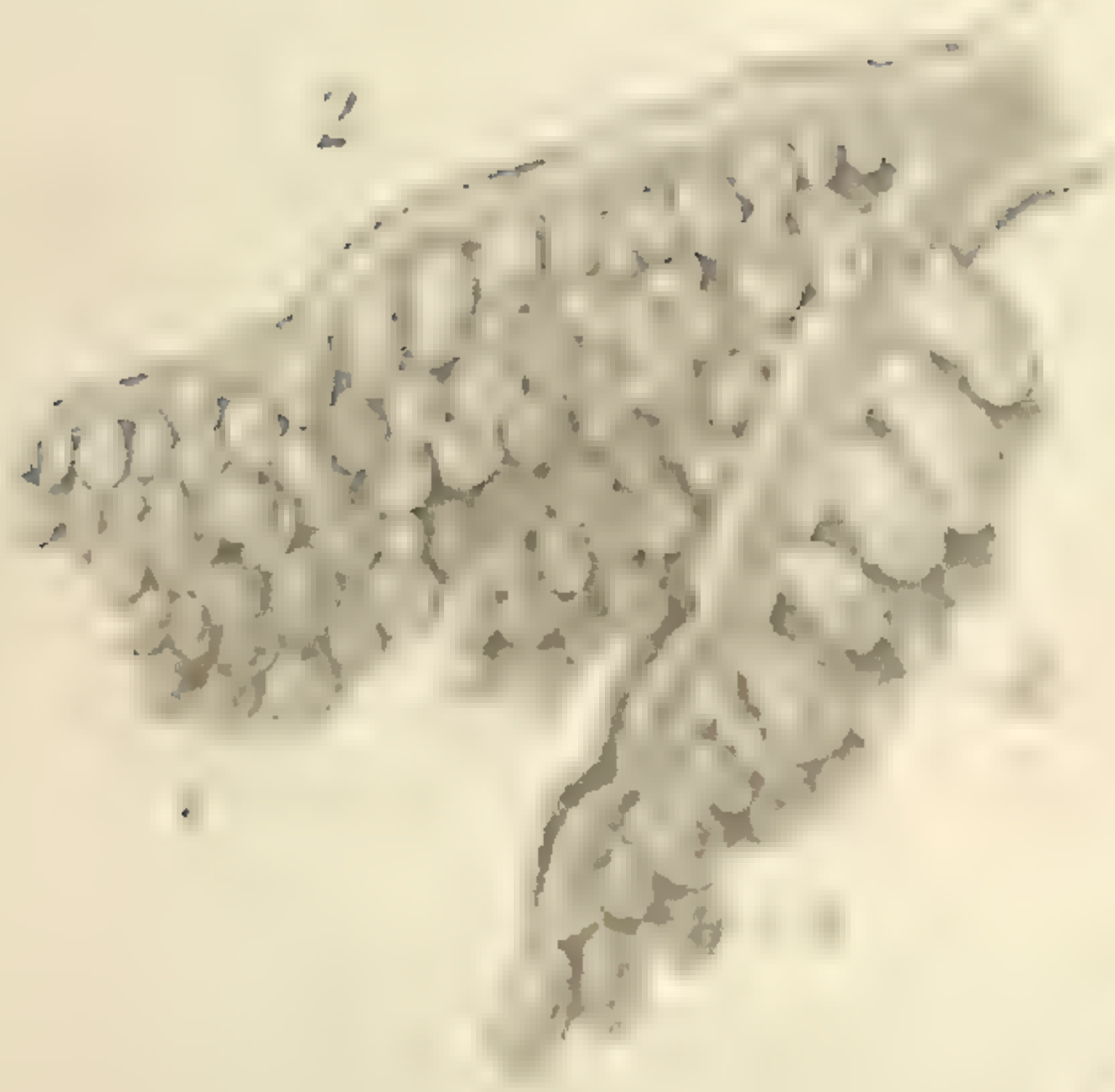

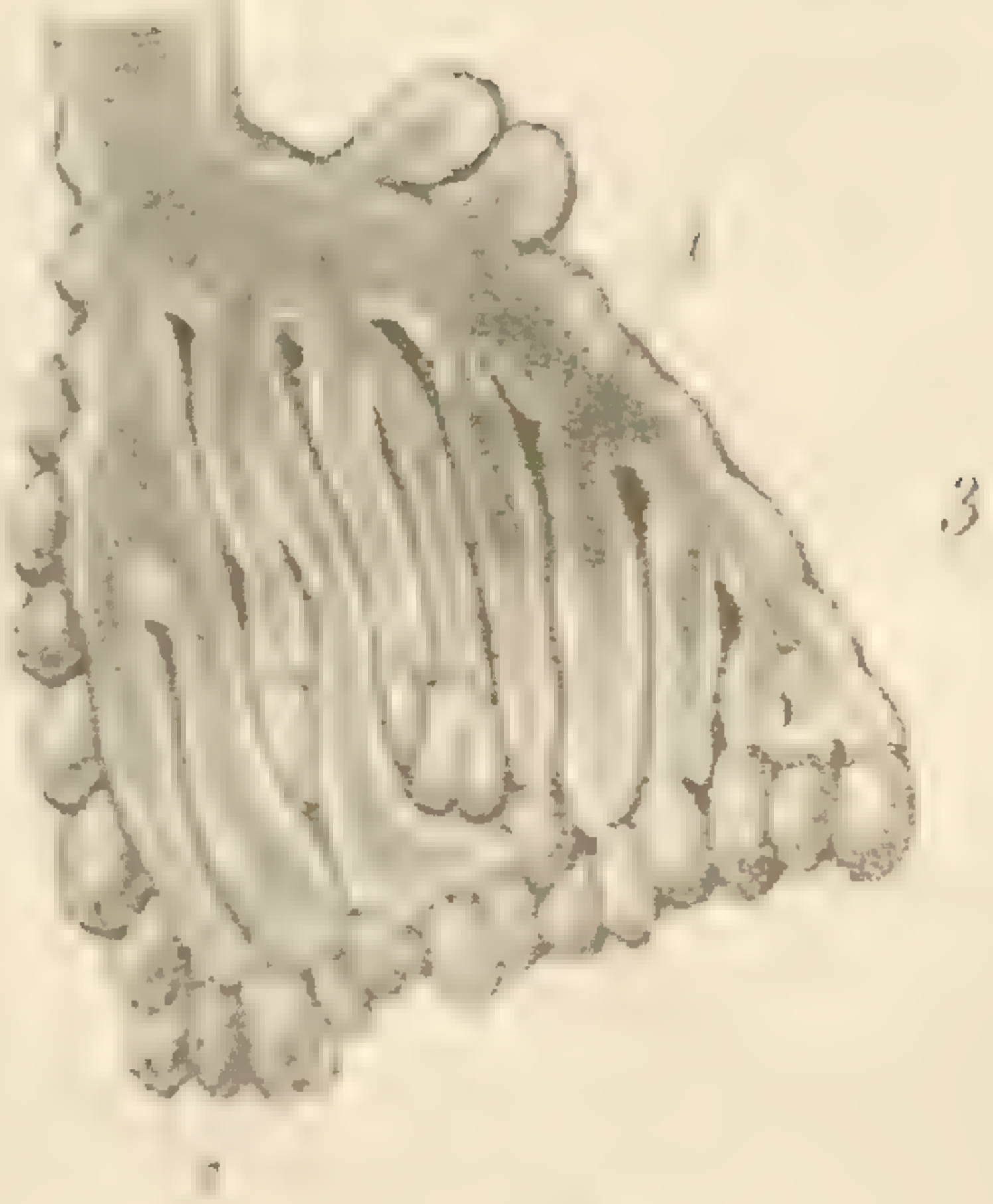

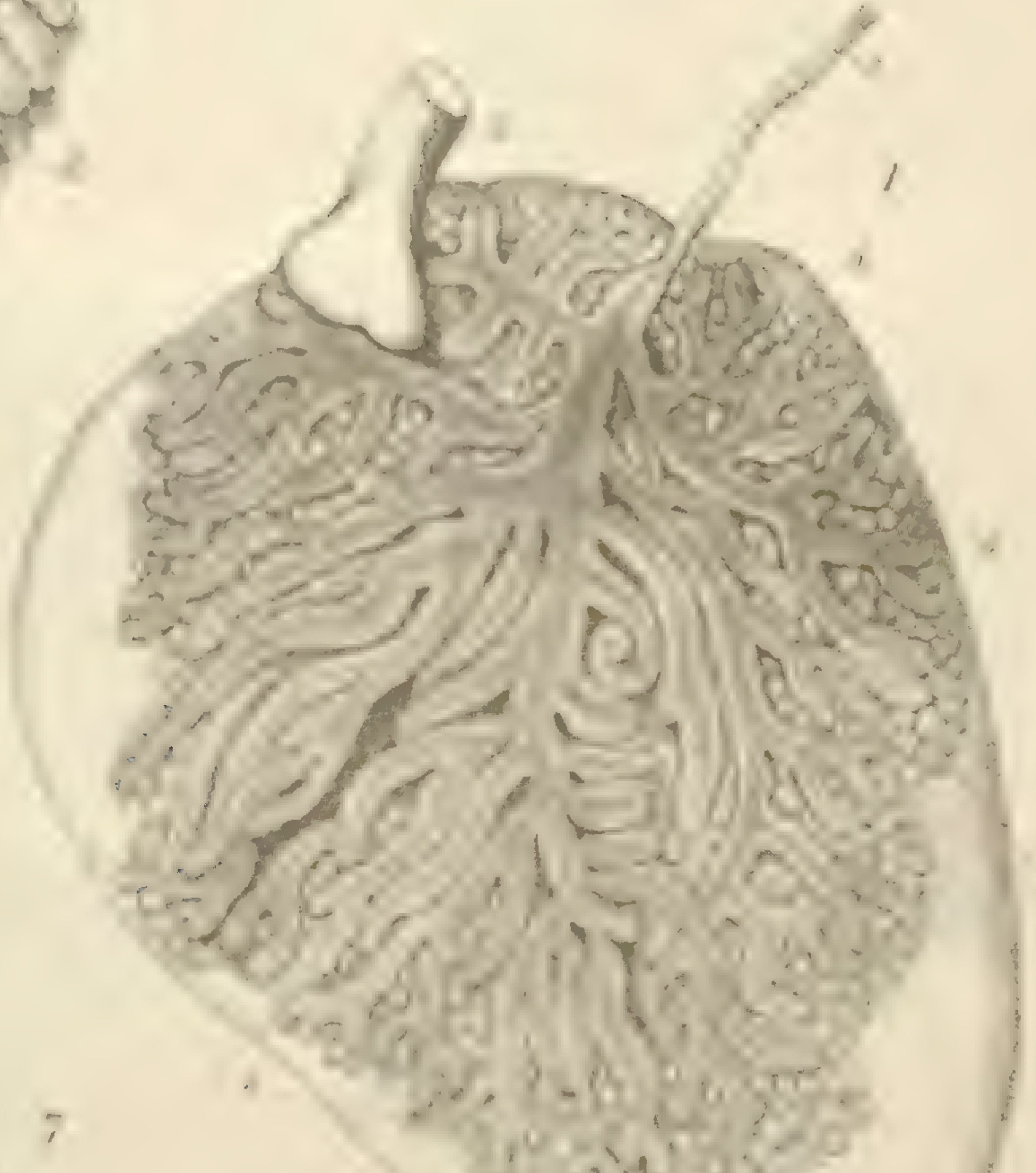

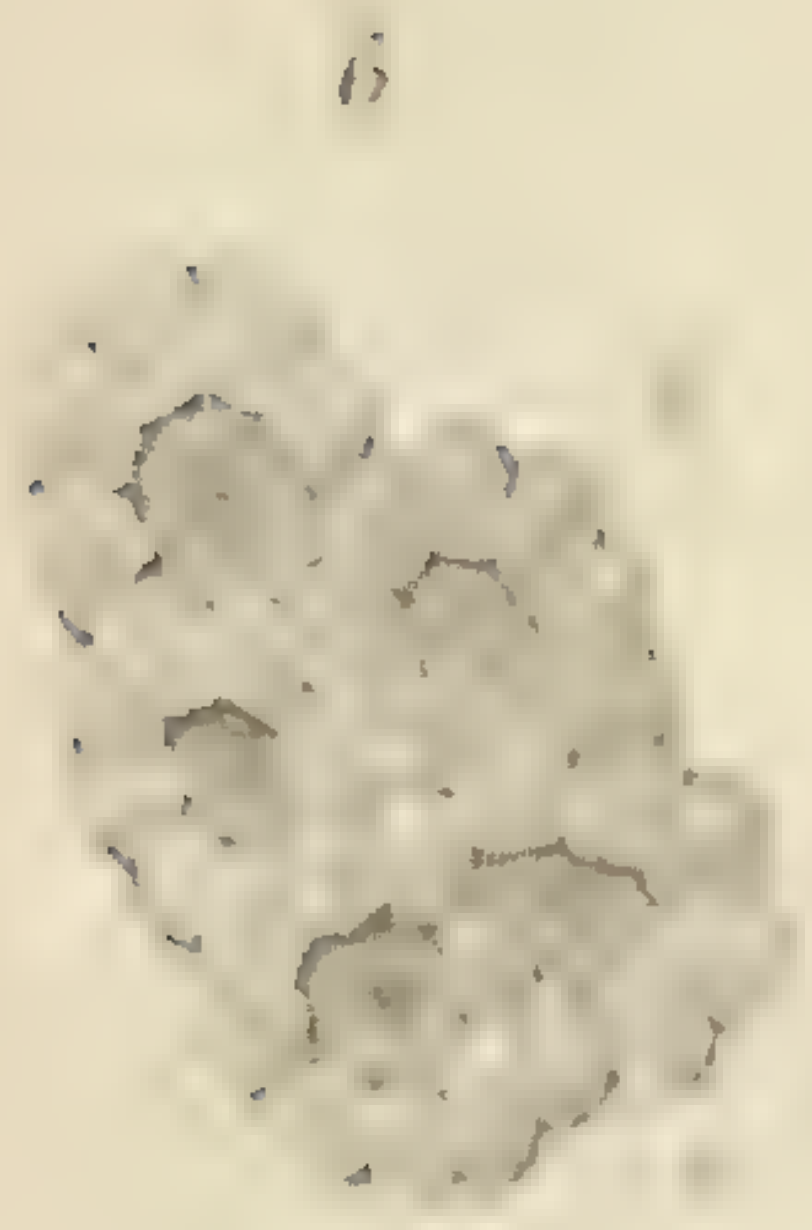

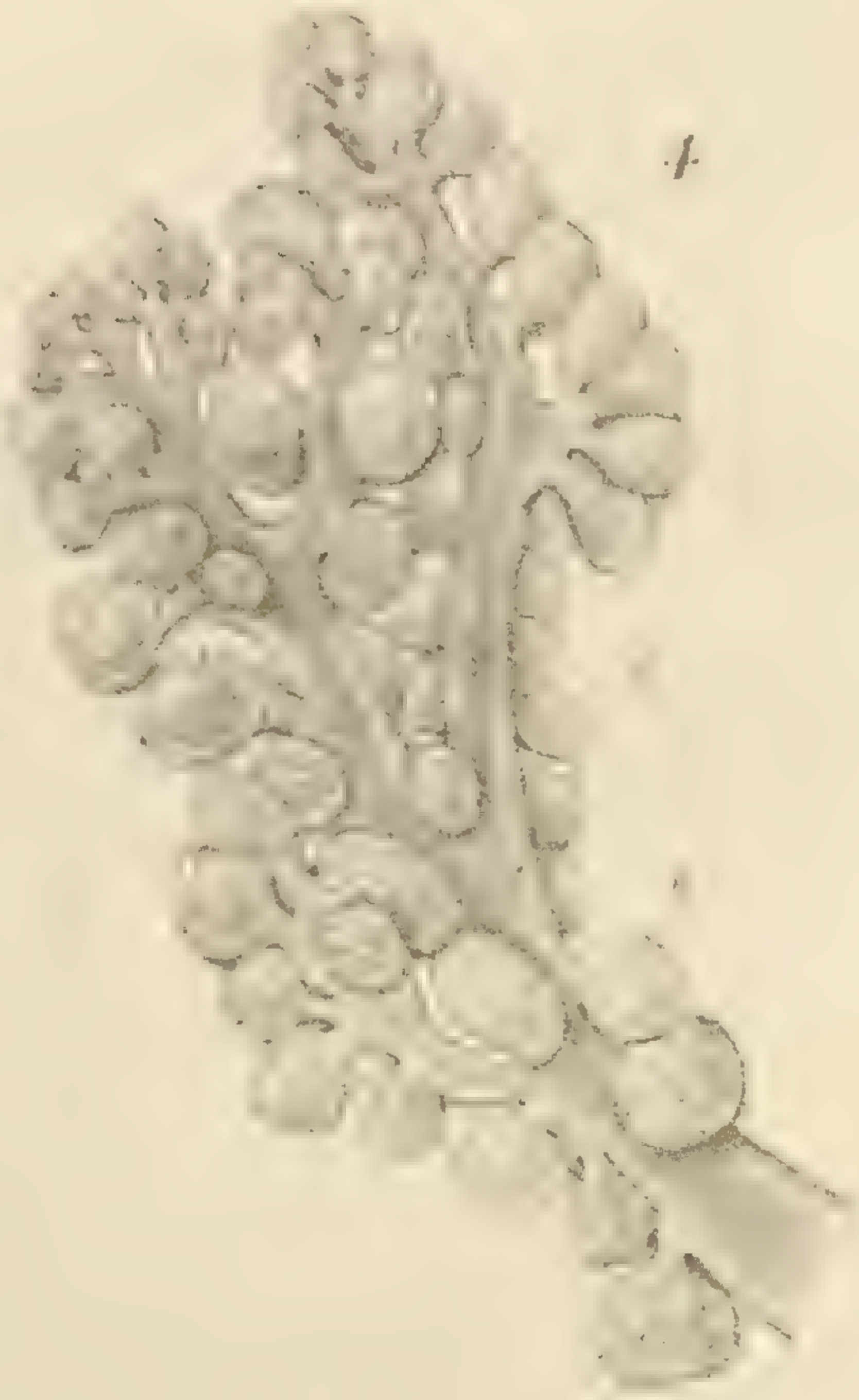

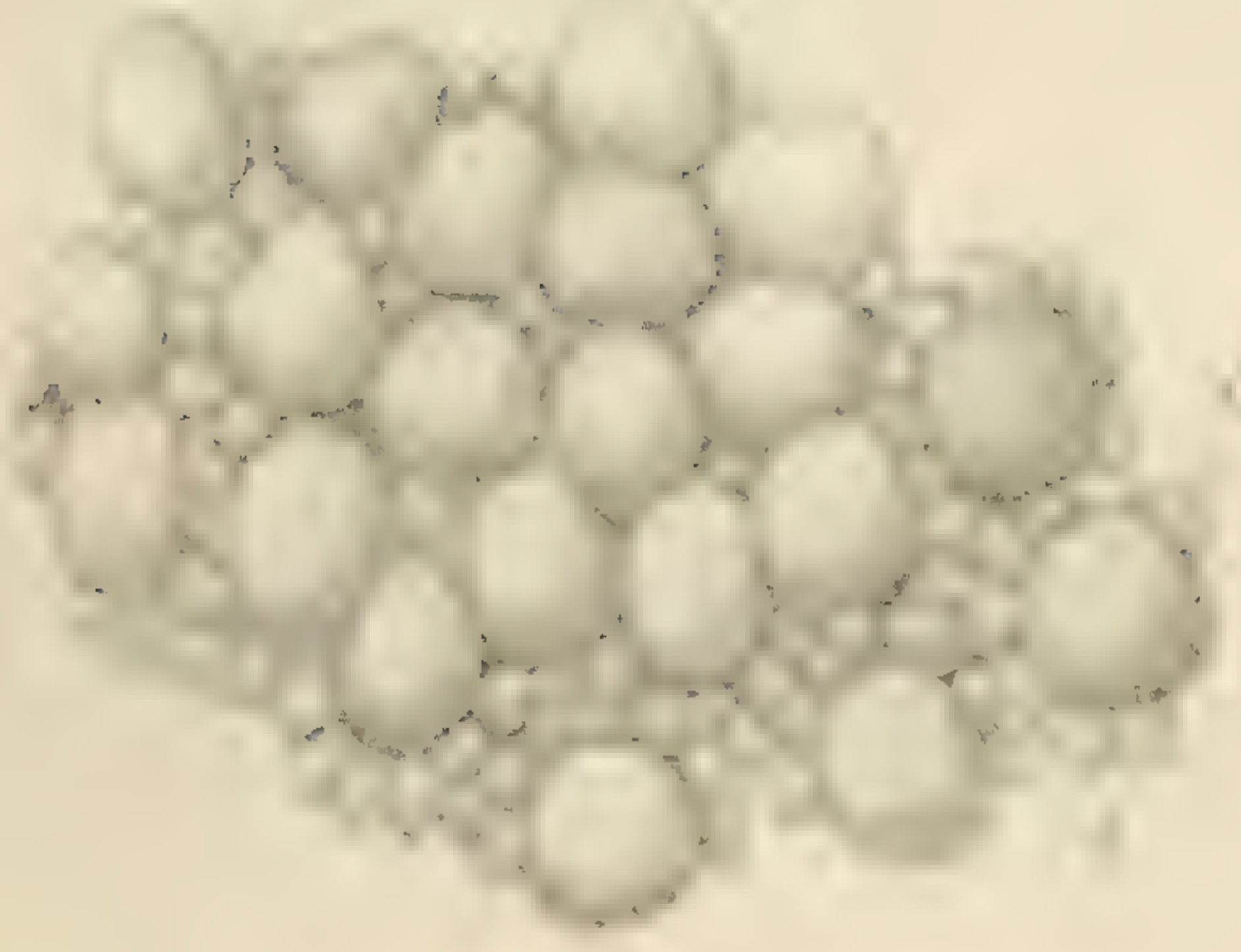

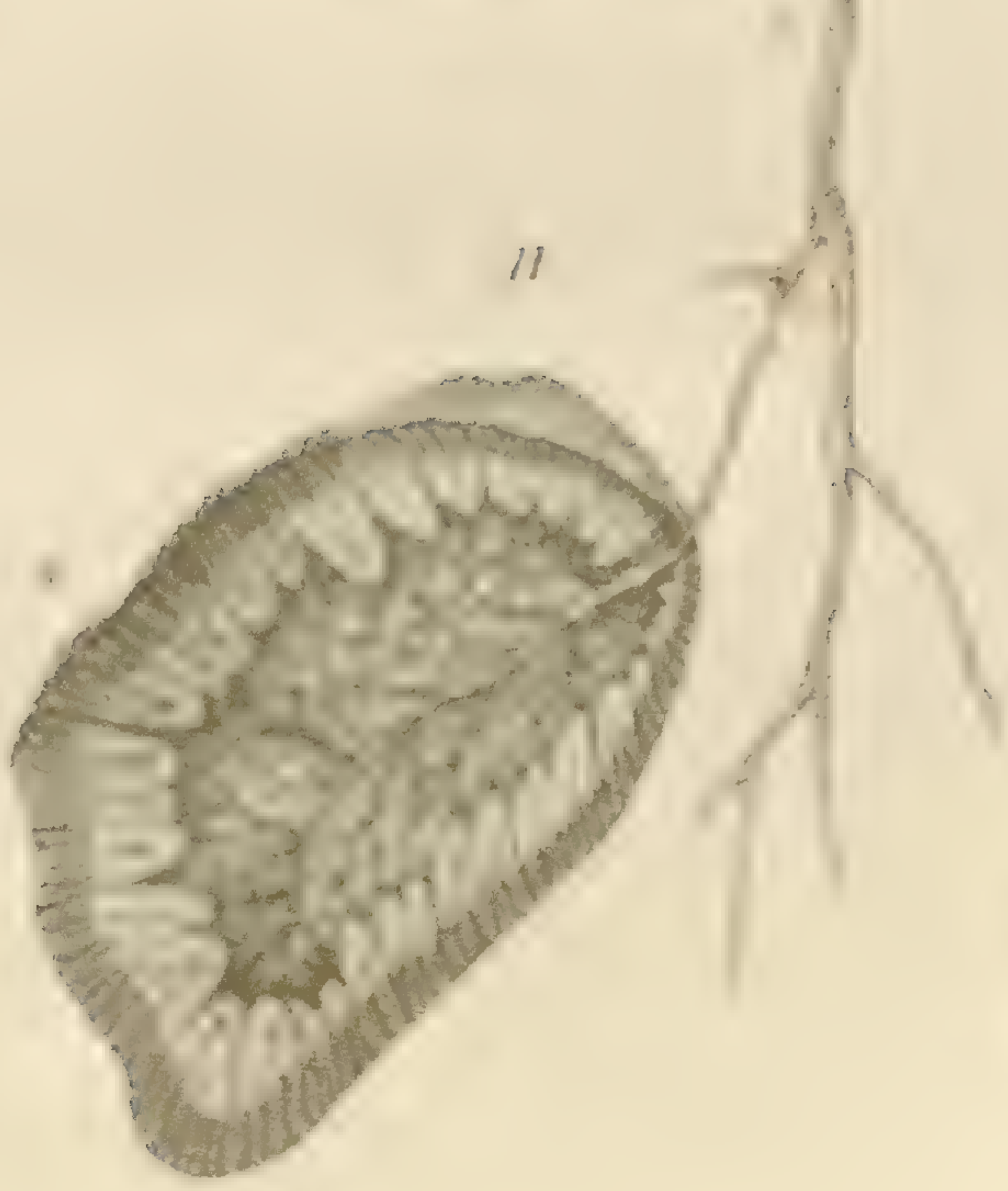

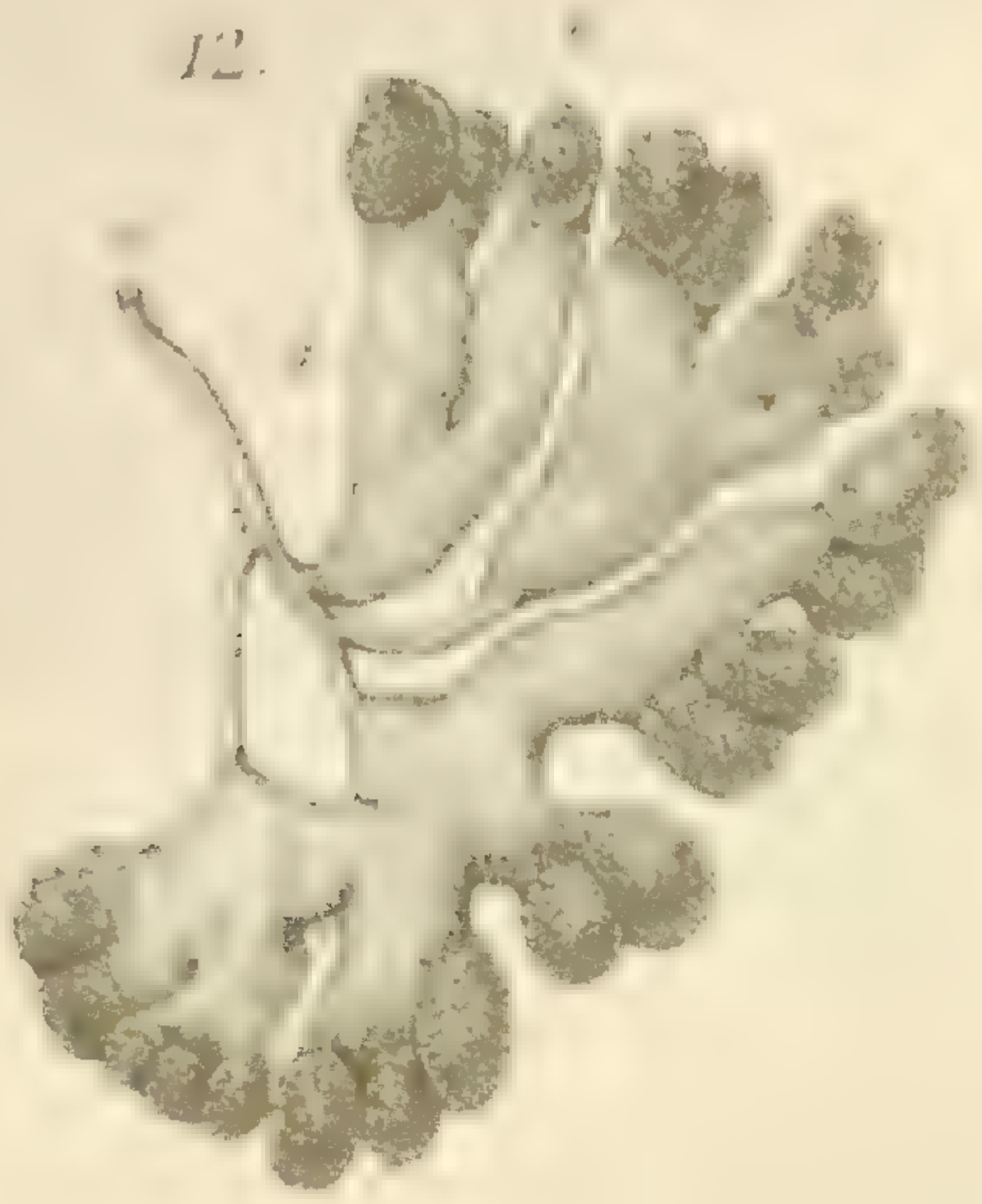

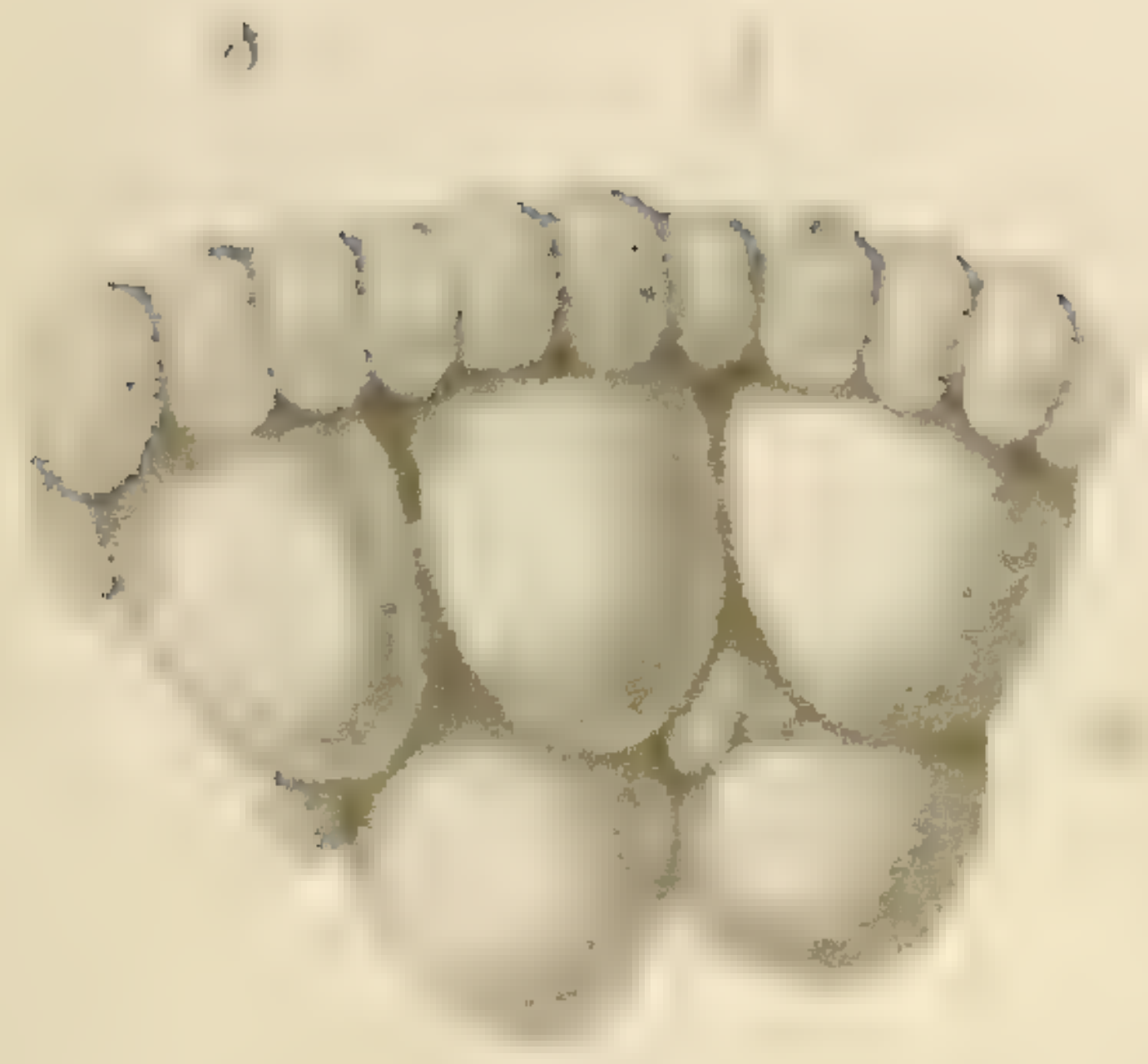

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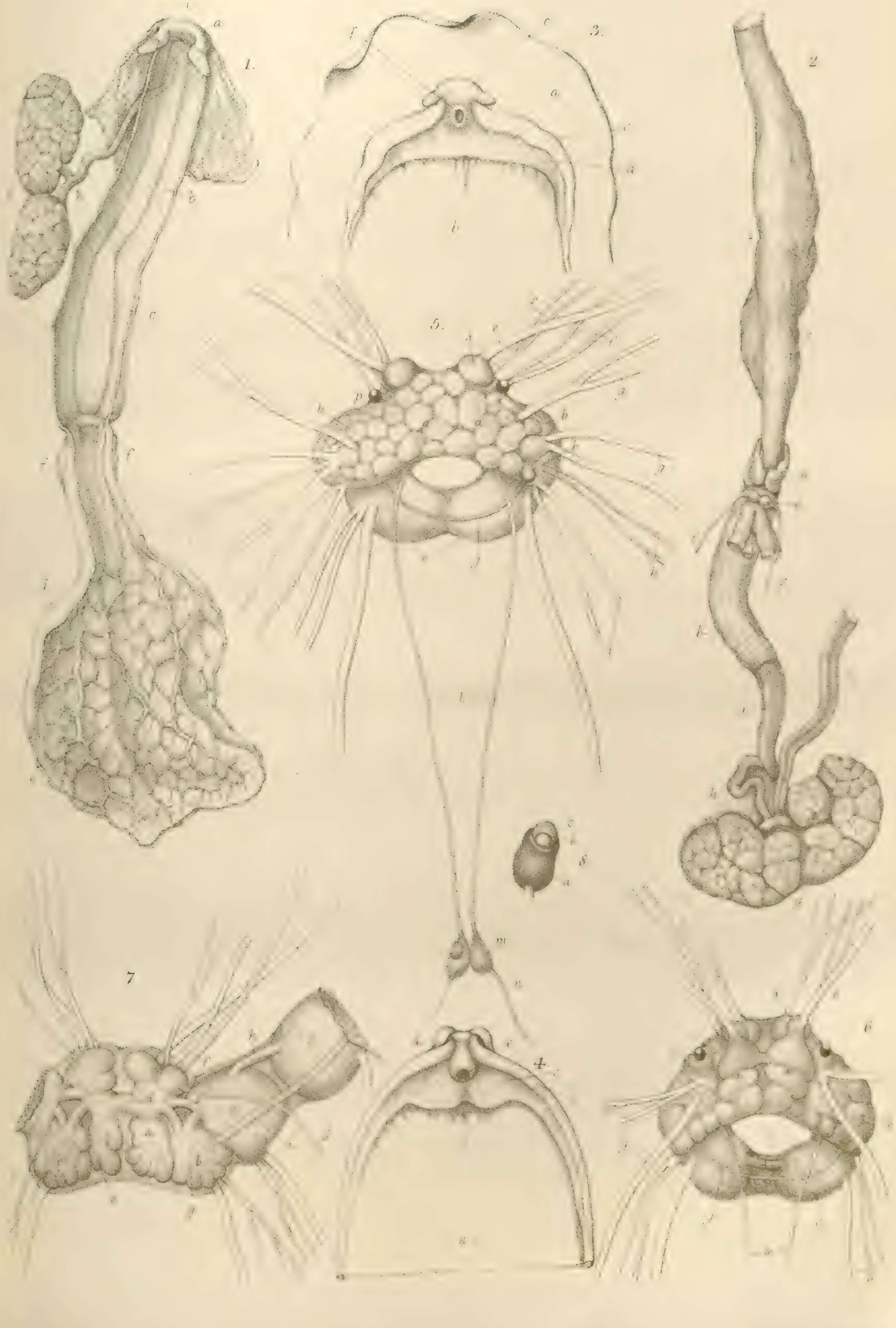
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V.—*A List of the Exogenous Plants found in the Anamallay Mountains in Southern India, with Descriptions of the New Species. By* Capt. R. H. BEDDOME, *Officiating Conservator of Forests in the Madras Presidency. Communicated by* Dr. T. THOMSON, *F.L.S.*

Read April 17, 1862, and March 16, 1865.

(Plates XXI.–XXVII.)

THE Anamallay Mountains rise to an elevation of nearly 9000 feet; their base is about 1000 feet above the sea. The teak-forests are of great extent, and all the fine teak is found between 1500 and 2500 feet elevation. At these elevations it is very fine, and grows to a very large size. I have measured trees 20 feet in circumference. The teak-forest is dry and comparatively open, and is swept through by the fires in February or March. Other fine timber-trees are abundant, chiefly the two black woods, *Dalbergia latifolia* and *D. sissoides*, the Ven Tek (*Lagerstrœmia microcarpa*), several Terminalias, *Pithecolobium xylocarpum*, and *Pterocarpus marsupium.* The underwood is chiefly formed of *Dendrolobium cephalotes, Pueraria tuberosa*, and *Cycas.* Orobanchs, terrestrial Orchids, and Balsams are abundant. Of Ferns, the most abundant are *Cyclodium Cumingianum, Nephrodium molle*, and *Lastrea cochleata.* Bamboo abounds, generally forming large copses in the moister parts of the forest. Teak grows in small quantities up to 3500 and 4000 feet elevation; but it is stunted and scraggy at these higher elevations. The moist forest (or Shola) forms large tracts on these mountains, and has quite a different vegetation to the dry forest. The trees are often of gigantic growth. Euphorbiaceæ, Urticaceæ, and Anonaceæ abound; and the trees are quite covered with epiphytic Orchids and other parasites. Gigantic creepers (*Mezoneuron cucullatum, Xanthoxylon tetraspermum, Entada, Tiliacora*, and many others) quite cover many of the trees. Ferns and Balsams are very abundant. These forests are moist all the year round, and are never touched by the fires. The underwood is chiefly formed of Acanthaceous plants. *Strobilanthes tetraptera* covers miles. I have described several new trees from these moist forests; and a good many that are very common have recently been described by Mr. Thwaites, in his enumeration of Ceylon plants. I feel convinced that there are many new ones still to be discovered, as there are many trees that I have not been able to procure in flower. Above 4000 feet these moist forests alter considerably in vegetation; Lauraceæ and Myrtaceæ become very common. Above 5000 feet there is no dry forest, the country consisting of grassy tracts and Shola-forests, which are not nearly so dense as the moist forests at a lower elevation, nor are the trees nearly so large. The Bracken (*Pteris aquilina*) is very abundant on these mountains, from 3000 feet upwards. *Rhododendron, Anemone*, and *Ranunculus* commence at 5000 feet. Balsams abound towards the summit of these mountains; most of the species are quite distinct from those of the Neilgherries and Pulneys. I have described the new species in a paper in the Madras Journal of Science. It is a curious fact, that the Rose and the Strawberry are not to be found on these mountains, though they are both so abundant on the adjacent mountains, the Neilgherries and Pulneys.

ANONACEÆ.

CYATHOCALYX ZEYLANICUS, Champ.; very common in the moist forests, up to 2500 feet.

UNONA PANNOSA, Dalzell; very common in the same localities as the last species; called *Chen náree* by the hill tribes, and much valued for its fibre.

POLYALTHIA COFFEOIDES, Benth.; moist forests, at 3000 feet elevation; yields a very strong fibre, which has a most disagreeable odour.

OROPHEA ERYTHROCARPA, n. s.; foliis ellipticis, acuminatis, $2\frac{1}{2}$–$3\frac{1}{2}$ poll. longis, 1–2 latis, junioribus subpubescentibus demum supra glabris, pedunculis axillaribus vel supraaxillaribus pubescentibus, petiolo longioribus 3–4-floris, pedicellis pubescentibus pollicaribus, sepalis petalisque pubescentibus, staminibus 12, biseriatis, exterioribus interdum sterilibus, ovariis 6, dense strigosis biovulatis, carpellis oblongis rubris, semine 1 scrobiculato.

A middling-sized tree, very common in moist woods, at 1500 to 2500 feet elevation.

OROPHEA THOMSONI, n. sp.; foliis ovato-ellipticis, glabris, longe et obtuse acuminatis, $1\frac{1}{2}$–2 poll. longis, 1–$1\frac{1}{4}$ latis, pedunculis brevissimis, axillaribus, 3-floris, strigosis, pedicellis brevissimis, sepalis petalisque exterioribus strigosis, petalis interioribus longe et anguste unguiculatis, intus puberulis, staminibus 10–12 biseriatis, ovariis 5–6, hirtis, biovulatis, carpellis globosis pisi magnitudine.

A small tree, common with the preceding.

TAB. XXI. Fig. 1. Flower-bud. Figs. 2, 3. Expanded flower; front and back views. Fig. 4. Stamen. Figs. 5, 8. Gynæcium. Figs. 6, 9. Carpels. Figs. 7, 10. Longitudinal section of carpel, showing ovules, all magnified.

MENISPERMACEÆ.

COCCULUS LAURIFOLIUS, DC.; very common. At 5000 feet it forms a small tree, and in the lower forests it is sometimes an erect shrub and sometimes scandent.

CAPPARIDEÆ.

CAPPARIS FORMOSA, Dalz. Moist forests, at about 3000 feet.

CAPPARIS MOONII, Wight. With the last.

SAMYDACEÆ.

CASEAREA CORIACEA, Thwaites, Enum. Zeyl. p. 20. Common at an elevation of 6000 feet, in moist woods.

TILIACEÆ.

GREWIA ACUMINATA, n. sp.; arbor parva, ramulis glabris, foliis oblongis longe acuminatis integerrimis glabris, 4–6 poll. longis, 2 poll. latis, petiolo $\frac{1}{4}$ poll. stipulis parvis subulatis, pedunculis brevissimis lateralibus vel axillaribus 2–5-floris, minute bracteolatis, sepalis cinereo-pubescentibus.

At an elevation of 3000 feet; rare.

OLACINEÆ.

Anacolosa densiflora, n. sp.; arbor excelsa, ramulis teretibus, foliis alternis glabris, lucidis, breve petiolatis, oblongis, obtuse acuminatis, basi rotundatis, 4–5 poll. longis, 1½–2 latis, petiolo ¼-poll. floribus axillaribus fasciculatis, fasciculis 7–20-floris pedicellis ¼ poll. longis, floribus (pro genere) magnis ¼-pollicaribus, pallide flavis, odoratissimis, calyce 4–6-dentato, petalis intus villosis, filamentis glabris, ovario biovulato, stylo erecto, apice tridentato.

Tab. XXII. Fig. 1. Flower. Fig. 2. Petal and stamen. Fig. 3. Stamen. Fig. 4. Flower with petals removed. Fig. 5. Ovary. Fig. 6. Longitudinal section of ovary, with stamens. Fig. 7. Transverse section of ovary. All magnified.

Miquelia dentata, n. sp.; alte scandens, ramulis glabris, foliis late ovatis acuminatis, basi subtruncatis leviter cordatis profunde irregulariter dentatis, 8 poll. longis, 4 latis, pedunculis 1–1½-pollicaribus gracilibus, apice umbellatim multifloris, fœmineis solitariis, masculis basi bracteatis, in racemum brevem supra axillarem dispositis.

Tab. XXIII. Fig. 1. Flowering branch. Fig. 2. Flower-bud. Figs. 3, 4. Expanded flower. Figs. 5, 6. Back and front view of stamen. Fig. 7. Fruiting branch. Fig. 8. Fruit. Fig. 9. Longitudinal section of fruit. All but figs. 1. & 7 magnified.

AURANTIACEÆ.

Glycosmis pentaphylla, Oliver. There are three very distinct varieties of this species (if they can be all looked upon as belonging to one species); two of the true Pentaphylla group always differ from each other, the one in having its anthers attached on the inner surface of the filament below its apex, and the other in having its anthers terminal, attached to a small apiculate process at the apex of the dilated filament.

Clausena Wildenovii, W. & A.

There is a variety of this plant in the moist woods, up to 2500 feet elevation, which bears a delicious, eatable, succulent fruit. It grows to a good-sized tree, and is covered with ripe fruit in July. I fully described it in the Madras Journal, 1861, under the name of *Cookia dulcis*; but Mr. Oliver does not consider it more than a variety of *C. Wildenovii*.

Clausena indica, Oliver. Common in moist woods, at about 3000 feet elevation.

Luvunga scandens, Ham. Common with the last.

Luvunga eleutherandra, Dalz. Moist woods, at 3000 feet. Common.

GUTTIFERÆ.

Calophyllum bracteatum, Thwaites, En. Pl. Zeyl. 51. The poon-spar tree of our western coast, abundant on the Anamallays, Wynaud, and elsewhere in moist woods, up to 3000 feet elevation, answers well to Thwaites's description of *C. bracteatum*, except that the young leaves are perfectly glabrous. I have not seen a

specimen of Thwaites's plant; and if this is a new species, it might be called "*Calophyllum elatum.*"

Nephelium stipulaceum, n. sp.; arbor, foliis glabris, abrupte pinnatis, foliolis suboppositis 2–3-jugis, 2 inferioribus minimis obliquis stipulas simulantibus basi petioli approximatis, cæteris oblongis obtuse acuminatis, basi subattenuatis obliquis, 3–4 poll. longis, 2–3 latis, paniculis axillaribus et terminalibus pilosis, floribus polygamodioicis, fructu ovali 1–1½-pollicari, aculeis debilibus dense vestito, seminibus oblongis arillo succulento semiinclusis, testa fusca, cotyledonibus magnis carnosis.

Very common in moist woods, at 2000 feet.

Nephelium erectum, Thwaites. With the preceding, but rare.

Harpullia imbricata, Thwaites. Very common in moist woods, about 2000 feet. The flowers are polygamous.

Filicium decipiens, Thwaites. Very common up to 4000 feet.

SABIACEÆ.

Sabia limoniacea, Wall. At an elevation of 3500 feet.

MELIACEÆ.

Beddomea indica, Hook. f. Gen. pl. 1. 336; frutex scandens, foliis pedalibus impari-pinnatis, 3–5-foliolatis, foliolis ovatis vel oblongis, obtuse acuminatis, apicem versus subcrenulatis, subtus plus minus lepidotis, 4–7 poll. longis, 2–2½ latis, pedunculis pubescentibus axillaribus racemosis vel paniculatis, floribus breviter pedicellatis minute bracteolatis, sepalis extus pubescentibus.

Lansium anamalayanum, n. sp.; arbor mediocris, foliis 6–9-pollicaribus impari-pinnatis glabris, foliolis 3–5 ellipticis obtuse acuminatis, basi attenuatis, integris, 3–4 poll. longis, 1½–2 latis, floribus in spicas axillares dispositis, sepalis petalisque 5 tubo stamineo obsolete 10-lobo, antheris alternatim brevioribus, ovario sessili strigoso trilobo triloculari, loculis biovulatis, stylo vix ullo stigmate obtuse trilobo, fructu magnitudine uvæ magnæ, biloculari, seminibus in loculis solitariis arillatis.

Disoxylum binectariferum, Hook. f. In moist woods, at elevations of 2000–3000 feet.

There is another species of this genus, which I have only seen in fruit. It is an enormous tree, and is called *Párapà* by the hill tribes. It is probably an undescribed species. The fruit is quite round, larger than a billiard-ball, of a bright yellow colour, very hard, roughly tubercled, 3–4-celled; the seeds bluntly three-sided, attached by their whole inner face to the central placenta, with a reddish-brown testa, and the radicle immersed between the large fleshy green cotyledons.

Amoora Rohituka, Roxb. In moist woods, at 3000 feet.

Milnea Roxburghiana, W. & A. In moist woods, at 3000 feet.

Heynea trijuga, Wall. In moist woods, at 3000 feet.

AMPELIDEÆ.

Vitis gigantea, n. sp.; scandens, trunco diametro 4–5-pollicari, cortice suberoso, ramulis

glabris teretibus, foliis simplicibus exacte cordatis sinu profundo, longe acuminatis et mucronatis, 6–8 poll. longis, 5–6 latis, supra glabris, subtus tomentosulis, crenatis, crenaturis argute dentatis, 5-nerviis valde reticulatis, petiolis foliis ½ vel ⅓ brevioribus, cirrhis bifidis, stipulis glandulosis, pedunculis petiolo brevioribus cymosis, cymorum ramis 3–5 apice umbellatis, vel ramos 2–3 apice umbellatos gerentibus, floribus minutis viridibus.

Anamallay forests, in moist woods, at 2000 feet elevation. An enormous climber.

Vitis anamalayana, n. sp.; glabra, foliis ramorum juniorum simplicibus ovato-lanceolatis, adultorum plerumque trifoliolatis, petiolo 1–2-pollicari, foliolis ovato-lanceolatis longe acuminatis, argute serratis, subtus conspicue reticulatis, 3½–4 poll. longis, 2 poll. latis, petiolo partiali brevi glanduloso, lateralibus valde inæquilateralibus basi obliquis, cirrhis ramosis ad divisiones minute stipellatis, floribus laxe cymosis, pedunculo foliis breviore.

A very large creeper, growing on banks of rivers, at 5000 feet. My flowering specimens are not very perfect.

BALSAMINEÆ.

Of the new species described by me in the Madras Journal of Science, *Impatiens gracilis* is the same as *I. acaulis*, Arn. I have one species in my herbarium still undescribed; but my specimens are not perfect enough to enable me to describe it, and I have lost the notes that I made at the time of gathering it. It belongs to the section Scapifloræ, and has large oblong cordate leaves, very long bracteated scapes, floriferous towards the apex; flowers on long slender pedicels much smaller than those of *I. rivalis* and *I. acaulis*, but with enormously long spurs. It is one of the most beautiful of the genus. I found it in moist woods at 4000 feet elevation on the Anamallays, and also on the Neilgherries; it is very abundant about Professor Owen's coffee-plantation on the Sisparah Ghat.

RUTACEÆ.

Xanthoxylon tetraspermum, W. & A. Common in moist woods. From the wood of this creeper, when cut through in two places, abundance of water exudes, which is drinkable.

Dipetalum biloculare, Dalz. Common in moist woods, at 2000 feet elevation.

Evodia triphylla, DC. Very common. Yields a strong timber.

CELASTRACEÆ.

Microtropis latifolia, Gardn. Common in woods, at a high elevation.

Microtropis ramiflora, Wight. Common with the last.

Glyptopetalum zeylanicum, Thwaites. Common in moist woods, up to 2500 feet elevation.

Euonymus pterocladus, Hohen. (*E. angulatus*, Wight). Common.

Euonymus dichotomus, Heyne. Common.

Euonymus revolutus, Wight. Common.

Euonymus crenulatus, Wall. Common.

I have an undescribed species of *Euonymus*, with downy leaves, but I have only been able to find it in fruit.

TEREBINTHACEÆ.

Glycicarpus racemosa, Dalz. Very common.

Canarium strictum, Roxb. The black dammer-tree. Very abundant in moist woods, up to 3000 feet.

CHAILLETIACEÆ.

Moacurra gelonioides, Roxb. Common at 3000 feet elevation, in moist woods.

LEGUMINOSÆ.

Crotalaria elegans, n. s.; herbacea erecta, glabra, foliis apice acuminatissimis, nervis vix conspicuis, anguste linearibus 4–6 poll. longis, 2 lin. latis, stipulis nullis?, racemis terminalibus multifloris, bracteis axi adnatis, ovatis, longe acuminatis, floribus flavidis longe pedicellatis, calyce ad medium fisso labio superiore bifido, legumine stipite brevi crasso insidente oblongo sursum crassiore glabro polyspermo.

Grassy places at 4000 feet. A very distinct species, with very curious bracts.

Crotalaria lanata, n. sp.; fruticosa erecta 12–15-pedalis, caule angulato, foliis oblongis ovalibus v. suborbiculatis mucronatis, 4–5 poll. longis, 2–2½ latis, supra glabris, subtus cum ramulis tomento albo dense lanatis, stipulis maximis transverse lunatis, racemis terminalibus, calyce pubescente ad medium fisso labio superiore bifido, bracteis ovatis longe acuminatis, floribus magnis flavis, legumine glabro polyspermo.

Common on dry ground, at 4000 feet.

Crotalaria humifusa, Grah. At 4000 feet.

Crotalaria acicularis, Ham. At 4000 feet.

Crotalaria triquetra, Dalz. At 4000 feet.

Crotalaria multiflora, Benth. At 4000 feet.

Crotalaria longipes, Wight. At 4000 feet.

Crotalaria Priestleyoides, Benth.* At 4000 feet.

Crotalaria Heyneana, Grah. Common in the teak-forests, up to 3000 feet.

Crotalaria dubia, Grah. Common with the last.

Crotalaria stipitata, Grah. Common up to 3000 feet.

Crotalaria obtecta, Grah. Up to 3000 feet.

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* Mr. Bentham has kindly favoured me with the following diagnosis of this unpublished species:—

"**Crotalaria Priestleyoides** (§ Calycinæ), n. sp.; perennis adscendens v. erecta, pilis longis vestita, foliis crebris obovatis oblongisve utrinque pilosis, racemis capitatis paucifloris, calycis rufo-hirsutissimis laciniis lanceolatis vexillum æquantibus, legumine sessili glabro calyce breviore."

SMITHIA CAPITATA, Dalz. At 3000 feet, common.

SMITHIA SETULOSA, Dalz. Common at 3000 feet.

DESMODIUM OSMOCARPOIDES, DC. Very abundant in the teak-forests.

DESMODIUM PODOCARPUM, DC., var. GARDNERI. In moist forests, at 3000 feet.

DESMODIUM BETULOIDES, n. sp.; caule a basi ramoso angulato adpresse sericeo, foliis unifoliatis oblongo-lanceolatis acuminatis, supra glabris, subtus pallidis dense adpresse sericeis, 2¼–4 poll. longis, 1¼–1¾ latis, stipulis magnis scariosis lanceolatis acuminatis, stipellis 2 filiformibus ad apicem petioli 1–1¼-pollicaris, racemis terminalibus minute glanduloso-pubescentibus, bracteis lanceolatis, pedicellis brevibus strigosis 2–3 fasciculatis, calyce strigoso bilabiato, labio superiore integro, inferiore profunde bifido, legumine lineari 4–5-pollicari, glanduloso-hispido, sutura utraque leviter sinuata, articulis 6 8 elongatis subellipticis.

Common in moist forests at 2000 feet.

ALYSICARPUS RACEMOSUS, Benth. At 3000 feet elevation, on grass lands.

PUERARIA TUBEROSA, DC. This destructive creeper forms, with *Dendrolobium cephalotes*, the chief portion of the underwood in the teak-forests.

VIGNA WIGHTII, Benth.; scandens, caule strigoso, stipulis adnatis, foliis trifoliatis, foliolis superne adpresso-pubescentibus subtus molliter sericeis 2–2½ poll. longis, 1–1½ latis, petiolo 1–1½-poll., pedunculis axillaribus incrassatis 5–8 poll. longis, apice plurifloris, floribus odoratis magnis lilacinis brevissime pedicellatis, tuberculis glandulosis insidentibus, calycis lobis longe subulatis strigosis, legumine tereti, juniori strigoso, adulto glabro.

A very specious plant, well worth cultivating. Common at 3000 feet elevation.

DUNBARIA HEYNEI, W. & A. Lower forests.

DUNBARIA FERRUGINEA, W. & A. Lower forests.

DUNBARIA ROSTRATA, Benth. Lower forests.

ATYLOSIA CANDOLLII, W. & A. 5000 feet.

ATYLOSIA ALBICANS, Benth.;

ATYLOSIA RUGOSA, W. & A.;

ATYLOSIA MOLLIS, Benth. (*Dunbaria Horsfeldii*, Miquel). All three common at 3000 feet elevation.

MILLETTIA SPLENDENS, W. & A. At 3000 feet elevation.

I have three species of this genus from these hills, which seem undescribed; two, however, are only in flower, and the third only in fruit; so that I will not attempt at present to name them.

RHYNCHOSIA FILIPES, Benth. At 4000 feet elevation, common.

FLEMINGIA INVOLUCRATA, Wall. Foot of the hills.

DALBERGIA GARDNERIANA, Benth. 6000 feet elevation.

Dalbergia sissoides, W. & A. Lower forests. This is the smaller black wood: the wood is much darker than *D. latifolia* (*Eetee marum*), and is called *Eroopootoo marum.*

Derris paniculata, Benth. Banks of rivers, at 3000 feet.

Derris Heyneana, Benth. At the elevation of about 5000 feet.

Mezoneuron cucullatum, W. & A. The stem of this plant, when cut across, yields pure water, just as that of *Xanthoxylum tetraspermum* does.

Pithecolobium anamalayanum, n. sp.; ramulis petiolis paniculisque fusco-pubescentibus, foliis 6–8-pollicaribus, pinnis 6–8-jugis, 3–4½ poll. longis, foliolis oblongis falcatis superne fere glabris, subtus parce pubescentibus 3–4 lin. longis, 1–2 lin. latis, glandulis concavis 1–3 petiolo infra pinnis insertis, una inter utrumque jugum pinnarum exacte intermedia, capitulis sub-12-floris, calyce aureo-puberula, corolla calyce duplo longiore extus puberula, staminibus longe exsertis, ovario longe stipitato pubescente, legumine puberulo cochleato, seminibus 8–10.

A middling-sized tree, common at 6000 feet.

Nearly allied to *P. subcoriaceum*, Thw., but seemingly distinct in the smaller leaflets and more numerous pinnæ. I have not seen a specimen of Mr. Thwaites's plant.

MELASTOMACEÆ.

Osbeckia reticulata, n. sp.; frutex erectus 4–5-pedalis, caule strigoso, foliis ovatis basi cordatis 5–7-nerviis, subintegerrimis, 1–3 poll. longis, 1½–2 latis, utrinque dense adpresse strigosis, subtus profunde reticulatis, petiolis 3–10 lin. longis, dense strigosis, floribus terminalibus breviter pedunculatis maximis, calycis tubo campanulato dense squamoso, squamis valde setosis setis basi latis, limbi lobis obsoletis, antheris 8 haud rostratis, stylo clavato apice incurvo.

This very handsome shrub occurs at elevations above 6000 feet.

Osbeckia gracilis, n. s.; frutex erectus, gracilis, subglaber, foliis distantibus anguste lanceolatis acuminatis leviter crenulatis trinerviis, utrinque parce adpresse setosis, supra (in sicco) valde rugosis, 2½–3 poll. longis, ½ poll. latis, petiolo 1½–2 lin. longo, pedunculis terminalibus et axillaribus 2–3-floris, floribus magnis breviter pedicellatis, calycis tubo setis paucis remotis, lobis 4 deciduis ciliatis setarum fasciculo terminatis, petalis 4 obovatis, staminibus 8, antheris erostratis, stylo recto.

At 4000 feet elevation. A species with much the appearance of *O. longicollis*, Benth.

Sonerila rotundifolia, n. sp.; herba acaulis bulbosa 4–8-pollicaris, foliis glabris longe petiolatis rotundatis basi cordatis, lobis approximatis, sese invicem obtegentibus 7-nerviis, nervis infra valde conspicuis, rubris, scapis foliis longioribus apice flores 3–6 secundos gerentibus, pedicellis brevibus crassis, floribus roseis majusculis petalis obovatis retusis.

Moist rocky places, 4000–6000 feet.

Sonerila acaulis, n. sp.; acaulis, foliis ovatis basi cordatis leviter crenatis, crenaturis

setosis, superne sparse albo maculatis, maculis setosis, subtus crystallinis, ad nervos sparse pilosis demum utrinque glabris, scapis folia æquantibus apice 6–20-floris, pedicellis brevibus recurvis, cum calyce parce glanduloso-setosis, calycis lobis parvis acutis, petalis roseis ovatis vel oblongis acuminatis, antheris anguste cordatis flavis, stylo staminum longitudine obtuso papilloso.

Moist rocky places up to 3000 feet.

Sonerila tenella, n. sp.; caule erecto, foliis oppositis, 1–1¼ poll. longis, 7–8 lin. latis, petiolis 4–8 lin. longis, canaliculatis, ovatis, apiculatis, tenuiter serratis, 3–5-nerviis, sæpe obliquis et basi inæqualibus, supra pilis longis albidis remotis tectis, subtus fere glabris, parium inferiorum internodiis elongatis, pedunculis 1–3-floris glabris, antheris cordatis acuminatis, capsula glabra.

Rocky places, at 3000 feet elevation. Allied to *S. Arnottiana*, Thw.

Pachycentria, Blume. There is a very beautiful, undescribed species of this genus growing in great abundance on *Rhododendron arboreum* on the higher ranges; but my specimens are too imperfect for description.

MYRTACEÆ.

Eugenia gracilis, n. sp.; arbor parva, ramulis puberulis, foliis petiolatis lanceolatis utrinque acuminatis glabris supra lucidis, 3–4 poll. longis, 1–1¼ latis, petiolis ⅓-pollicaribus, pedicellis axillaribus vel pedunculis brevibus axillaribus aut supraaxillaribus insertis, solitariis, longis, gracilibus, 1–1⅓-pollicaribus, cum calyce puberulis, petalis 4 albis calycis lobis duplo longioribus, fructu oblongo pollicari.

Banks of streams, at elevations of 3000–4000 feet.

CUCURBITACEÆ.

Trichosanthes anamalayanus, n. s.; cirrhis 2–3-fidis, foliis 3–5-lobis supra scaberrimis subtus pubescentibus irregulariter profunde serratis, diam. 4–5-pollicari, floribus albis, masculis racemosis, calyce quam in fœmineis majore et majus lacinioso, filamentis 3, rarius 4, discretis, tubi parti gibbosæ insertis, antheris coalitis, corolla intus valde hirsuta, fœmineis axillaribus solitariis aut binis bractea lanceolata, vel sæpius racemosis bracteis magnis laciniatis glandulosis suffultis, bacca globosa.

Moist woods, up to 4000 feet.

I have another undescribed species; but my specimens are not perfect enough for description: it has nearly glabrous, very glandular, deeply 3-lobed leaves and a globose berry, with the seeds immersed in a fetid green pulp.

BEGONIACEÆ.

Begonia anamalayana, n. sp.; acaulis, foliis reniformibus valde obliquis repandis vel sublobatis longe petiolatis, junioribus dense floccosis, adultis glabris supra lucidis subtus crystallinis, stipulis magnis scariosis, scapo plerumque foliis multo longiore, dichotomo cymoso multifloro, floribus masculis et fœmineis dipetalis.

Banks of streams in moist forests, at 3500 feet elevation.

Begonia crenata, Dalz. Common in moist woods, up to 3000 feet.

LORANTHACEÆ.

Loranthus Cleghornii, n. sp.; glaber, foliis oppositis ovatis obscure nervosis coriaceis, $2\frac{1}{2}$–$3\frac{1}{2}$ poll. longis, $1\frac{1}{2}$ latis, racemis axillaribus vel terminalibus multifloris, pedicellis brevissimis, bractea parva calycem amplectente, calyce integro vel vix dentato ovarium vix superante, corolla obscure aurantiaca recta glabra, basi ventricosa, ultra medium æqualiter 4-fida, segmentis lineari-cuneatis, bacca oblonga.

On *Rhododendron arboreum*, 5000 to 8000 feet elevation.

RUBIACEÆ.

Acanthera zeylanica, Arn.;

Neurocalyx Wightii, Arn.;

Argostemma Courtallense, Wight (=*A. connatum*, Dalz.);

Argostemma verticellatum, Wall. (=*A. glaberrimum*, Dalz.).

These four species are found on banks of streams, in moist woods, at 3000 to 4000 feet elevation.

Ophiorhiza falcata, n. sp.; erecta, glabra, foliis lanceolatis utrinque angustatis, subtus pallidissimis, stipulis magnis triangularibus vel subulatis, cymis axillaribus terminalibusque longe pedunculatis, ramis reflexis secundis subternis, quorum 2 bipartitis, bracteis magnis falcatis, calyce minimo, corolla in alabastro angulata, basi gibba, tubo infra lobos angustato, extus glabro, fauce intus supra antheras pilosa.

Moist woods, at 3000–4000 feet elevation.

Hedyotis buxifolia, n. sp.; frutex magnus, glaber, ramis teretibus, foliis breviter petiolatis valde coriaceis late ovatis glabris lucidis, nervis inconspicuis, 4–6 lin. longis, 3 lin. latis, marginibus recurvis, stipulis latis basi connatis vaginantibus, sursum in dentes filiformes margine ciliatos dorso pilosos divisis, pedunculis terminalibus vel in axillis superioribus $\frac{1}{4}$ poll. longis trifloris, floribus subsessilibus, bracteis filiformibus ciliatis, calyce cyathiformi dentibus 4 erectis subciliatis, corollæ fauce lobisque villosis, filamentis inclusis vel exsertis, antheris oblongis, stylo longe exserto, capsulæ coccis osseis.

At 6000 feet. Allied to *H. articularis*, R. Br., but distinguished by its very small, shining, veinless leaves.

Grumilea longifolia, n. s.; frutex magnus, glaber, foliis cuneato-oblongis breviter abrupte acuminatis, 8–12 poll. longis, versus apicem 2–$2\frac{3}{4}$ poll. latis, basin versus sensim attenuatis, petiolo 1–2-pollicari, stipulis lanceolatis acuminatis deciduis 1–2 pollicaribus, corymbis breve pedunculatis, multifloris floribus, viridescentibus magnis, bracteis minutis acutis, calyce breviter dentato, corollæ tubo brevissimo, fauce ad antherarum insertionem villosa, bacca oblonga, calycis limbo coronata.

A large handsome shrub, in moist woods, at 2000–3000 feet.

Hedyotis glabella, R. Br. Very common in bamboo-jungles.

Saprosma indica, Dalz. Common in moist woods, at 3000 feet.

Pavetta siphonantha, Dalz. At 6000 feet elevation.

VALERIANACEÆ.

Valeriana microphylla, n. sp.; herbacea erecta, glabra, foliis radicalibus longe petiolatis pinnatis, 3–4-pollicaribus, pinnis 10–12-jugis ½-pollicaribus suboppositis glabris margine ciliatis, integris, terminali interdum denticulato, oblongis, margine inferiore plerumque lobulo parvulo auctis, caulinis paucis, inferioribus radicalibus similibus, superiorum pinnis anguste linearibus, corymbis densis ad ramificationes villosis, bracteis lanceolatis puberulis.

Grassy plains, at 6000 feet.

MYRSINEÆ.

Ardisia serratifolia, n.sp.; frutex magnus, ramulis pedunculis petiolisque rufo-villosis, foliis petiolatis lanceolatis utrinque acuminatis argute serratis, 6–9 poll. longis, 1½–2 latis, supra ad nervos sparse villosis demum glabrescentibus, infra dense rufe villosis, pedunculis axillaribus solitariis, pedicellis 2–3 fasciculatis 6–8 lineas longis subglabris, calycis lobis lanceolatis acuminatis subglabris, alabastro acuminato calyce bis terve longiore, corolla glabra stylo filiformi.

Moist woods, at 2000–3000 feet.

EBENACEÆ.

Rospidios vaccinioides, DC. Common in moist woods, up to 4000 feet. It is a lofty tree.

SYMPLOCEÆ.

Symplocos rosea, n. sp.; fruticosa, glabra, foliis elliptico-oblongis abrupte acuminatis mucronatis, supra medium argute serratis, puberulis, 5–7 poll. longis, 2–2½ latis, petiolo 3–4-lineari, racemis 1–3-poll. puberulis, floribus roseis breve pedicellatis, calyce bracteolisque puberulis, fructu oblongo apicem versus attenuato glabro.

In moist woods, at 2000–3000 feet.

Symplocos uniflora, n. sp.; arbor parva, ramis glabris, foliis petiolatis ovato-oblongis serratis, 1½ poll. longis, 1 latis, petiolis ¼-poll., pedicellis axillaribus unifloris 6–8 lineas longis, floribus albis, bracteis 2 ovatis ad basin calycis, petalis 5 calycis lobis triplo longioribus, stigmate obtuse trilobo, ovario triloculari, fructu oblongo glabro.

At 5000 feet elevation.

JASMINACEÆ.

Chondrospermum smilacifolium, Wall. Moist woods, 2000 feet elevation.

APOCYNACEÆ.

Chonemorpha macrophylla, G. Don. In moist woods, at 3000 feet.

Beaumontia grandiflora, Wall. With the last.

Parsonsia spiralis, Wall.;

Anodendron paniculatum, A. DC.;

Tabernæmontana dichotoma, Roxb.;

Cleghornia acuminata, Wight.;

All in moist woods, at 3000 feet.

ASCLEPIADACEÆ.

Hoya pauciflora, Wight. Very common in moist woods, at 4000 feet.

Bidaria tingens, Decaisne. 4000 feet elevation.

Ceropegia candelabrum, Linn. At 4000 feet elevation.

Ceropegia vincæfolia, Hook. Very common about the teak-forests.

Ceropegia oculata, Hook. Common in moist woods, up to 4000 feet. A very variable species.

Ceropegia maculata, n. sp.; radice fibroso, caule volubili tereti glabro maculato, foliis ovatis acuminatis maculatis minute punctatis glabris ad basin laminæ glandula minuta munitis, $2\frac{1}{2}$–3 poll. longis, $1\frac{1}{2}$–2 latis, petiolo subpuberulo canaliculato pollicari, pedunculis petiolo parum brevioribus glabris, pedicellis 7–10 umbellatis pedunculum æquantibus v. paullo longioribus, floribus viridi-purpureis, sepalis subulatis, corollæ limbo tubo dimidio breviore lobis ciliatis, coronæ stamineæ lobis exterioribus bipartitis interioribus æquilongis alternantibus, folliculis teretibus 4–5-pollicaribus.

Common in moist woods, at 2000 and 3000 feet elevation. Much like *C. candelabrum*, Linn. (*C. intermedia*, Wight) in foliage and general appearance; but the structure of the staminal corona is quite different.

Ceropegia ensifolia, n. sp.; radice bulboso, caule volubili glabro, foliis anguste linearibus mucronatis basi angustatis, supra pilis paucis adpressis subtus glabris pallidis brevissime petiolatis, 4–7 poll. longis, $\frac{1}{4}$ poll. latis, pedunculis axillaribus folio dimidio brevioribus vel subæquantibus pubescentibus umbellatis, apice pluribracteatis, bracteis ovatis oblongis vel subulatis, umbellis interdum proliferis vel in paniculam abeuntibus, pedicellis pubescentibus, floribus ex albo viridescentibus, segmentis calycinis glabris subulatis corollæ tubi partis ventricosæ dimidio brevioribus, corollæ segmentis tubum æquantibus vel superantibus, coronæ stamineæ lobis exterioribus brevibus emarginatis ciliatis cum interioribus longe ligulatis alternantibus, folliculis elongatis teretibus.

In rocky places, at 2500 to 3500 feet. Common.

Ceropegia fimbriata, n. sp.; radice bulboso, caule erecto subpuberulo, foliis subsessilibus anguste ensiformibus basin versus angustatis margine minute ciliatis supra puberulis subtus excepta costa glabris, 5–6 poll. longis, 2–3 lin. latis, pedunculis axillaribus brevibus (6–8 lin. longis) paucifloris, pedicellis pedunculum æquantibus, basi bracteis paucis subulatis munitis, corolla viridi-purpurea fimbriis albo-purpureis, tubo sursum angustato sepalis subulatis quadruplo longiore, limbo lobis tubum æquantibus, cum fasciculo pilorum glanduligerorum alternantibus, coronæ

staminеæ segmentis exterioribus brevibus argute bifidis ciliolatis interioribus longis ligulatis exterioribus intus medio adnatis, folliculis longis teretibus.

Dry rocky places, 3000 feet.

A very beautiful species. The tufts of gland-tipped hairs are concealed within the corolla until the segments expand; they then hang down like a fringe round the apex of the tube. It is always an erect plant in its wild state, though becoming a creeper when brought into a garden soil.

Ceropegia gracilis, n. sp.; radice fibroso, caule volubili glabro, foliis breviter petiolatis ovato-ellipticis acuminatis minute ciliatis, supra parce pilosis pellucido-punctatis, subtus lucidis costa excepta glabris, pedunculis petiolo longioribus 2–5-floris, floribus maximis, tubo brevi basi ventricoso, limbi lobis tubo longioribus medio angustissimis sursum latioribus, coronæ stamineæ lobis exterioribus brevibus profunde bifidis pilis longis ciliatis, interioribus alternantibus distantibus longe ligulatis.

Moist forests, 4000 feet. Nearly allied to *C. oculata.*

GENTIANACEÆ.

Exacum macranthum, Arn. Very abundant on the higher ranges.

It has more rounded and thicker leaves than the specimens from Ceylon in the Hookerian herbarium, and rather larger flowers.

Exacum Wightianum, Arn. 4000 feet elevation.

Exacum Perrottetii, Gris. With the last.

Exacum pedunculare, L. This and the two next inhabit the lower forests.

Exacum petiolare, Gris.

Exacum sessile, L.

Ophelia gracilis, n. sp.; caule erecto, gracili, glabro, quadrangulo, foliis distantibus ovatis vel rotundatis obtusis sessilibus 6–8 lineas longis, corymbis terminalibus laxis, bracteis ovato-lanceolatis, pedicellis apicem versus parum alatis, calycis lobis 4 lanceolatis acuminatis, corolla 4-partita, lobis calyce vix longioribus filamenta superantibus, foveis glanduligeris mediis inconspicuis.

At 4000 feet elevation.

GESNERACEÆ.

All the species occur in moist forests, up to 4000 feet.

Isanthera permollis, Nees.

Jerdonia indica, Wight.

Epithema carnosum, Benth.

Klugia notoniana, DC.

Æschynanthus zeylanica, Gardn.

Rhynchoglossum obliquum, DC.

CONVOLVULACEÆ.

ARGYREIA FULGENS, Chois. Moist forests, 3000 feet elevation.

ARGYREIA ELLIPTICA, Chois. Teak-forests, abundant.

RIVEA ZEYLANICA, Thw.

(α.) POPULIFOLIA. Teak-forests.

(β.) HIRSUTA. Most abundant in the teak-forests.

RIVEA CUNEATA, Wight. Most abundant in the teak-forests.

IPOMŒA BRACTEATA, Wight. Common up to 3000 feet.

IPOMŒA PILEATA, Roxb. Common up to 3000 feet.

IPOMŒA PULNEYENSIS, n. sp.; dense strigoso-pubescens, caule procumbente tereti, foliis alternis distantibus anguste cordatis, 2 poll. longis, 6–8 lin. latis, petiolo 2–6 lin. longo, floribus axillaribus solitariis breviter pedunculatis, bracteis 2 linearibus calyci approximatis, floribus magnis lilacinis, sepalis 2 interioribus linearibus, 3 exteriora ovata longitudine superantibus.

SCROPHULARIACEÆ.

TORENIA PARVIFLORA, Ham. Common on the higher ranges.

CENTRANTHERA PROCUMBENS, Benth. In the teak-forests.

PEDICULARIS PERROTTETII, Benth. Common on the higher ranges.

ACANTHACEÆ.

THUNBERGIA MYSORENSIS, T. And. Moist woods, at 3000 feet.

THUNBERGIA HAWTAYNII, Wall. Abundant on slopes of hills, at 3000 feet.

STROBILANTHES TETRAPTERUS, Dalz. Forms the underwood in most of the forests, at 2000–3000 feet.

STROBILANTHES LURIDUS, Wight. Common in moist woods, at 5000 feet.

STROBILANTHES MICRANTHUS, Wight. Common with the last.

STROBILANTHES TRIFIDUS, Nees. Moist woods, at 2000 feet.

STROBILANTHES ANCEPS, Nees. Moist woods, at 2000 feet.

STROBILANTHES GRACILIS, n. sp.; frutex 16–18-pedalis, caule tereti glabro, foliis sessilibus basi auriculatis anguste lanceolatis longe acuminatis, basi attenuatis argute serratis utrinque glabris, 4–6 poll. longis, 1–1½ latis; paniculis terminalibus vel ex axillis superioribus laxe multifloris, glanduloso-puberulis, floribus oppositis, distantibus, bractea parva lanceolata suffultis, calycis lobis lineari-lanceolatis puberulis, corolla lilacina, staminibus 4, capsula acuta basi attenuata calyce ⅓ longiore.

Moist woods, at 6000 feet. A very handsome species.

STROBILANTHES ANDERSONI, n. sp.; frutex 20-pedalis, caule tereti hirsuto, foliis petiolatis ovatis acuminatis serratis, 9-pollicaribus 2–4½ poll. latis, petiolo hirsuto ½–2 poll. longo, pedunculis axillaribus, foliis multo brevioribus, floribus in capitulis

dense bracteatis congestis, bracteis magnis ovatis obtusis glabris vel margine ciliatis, calycis lobis anguste lanceolatis ciliatis, corolla glabra magna pallide cærulea, staminibus 4.

In moist woods, at 6000 feet, with the preceding. A very fine species.

BARLERIA PENTANDRA, Arn. Abundant, 4000–6000 feet.

PODOSTEMACEÆ.

DICRÆA ALGÆFORMIS, n. sp.; frondibus aphyllis, atroviridibus, compressis, multipartitis, segmentis loriformibus pluries dichotomis lobis linearibus obtusis, floribus versus basin segmentorum lateralibus, involucri diphylli basi squamis 2 brevibus suffulti foliis ovalibus obtuse galeatis carnosis, involucello integro pellucido florem involvente, staminodiis 2 subulatis, vel 3, tertio filamento adnato, antheris bilocularibus, loculo interiore paullo altius inserto, stigmatibus 2 subulatis deflexis, pedicello fructus elongato, capsula 8-costata.

In streams, up to 3500 feet; abundant on rocks. The flat black fronds resemble some species of sea-weed.

TAB. XXIV. Fig. 1. Flowering frond, natural size. Fig. 2. Portion of same, magnified. Fig. 3. Portion of floriferous frond. Fig. 4. Portion of fructiferous frond. Fig. 5. Bud covered by involucre. Fig. 6. Bud, after opening of involucre. Fig. 7. Involucel enclosing bud. Fig. 8. Expanded flower, with involucre. Fig. 9. Flower, more highly magnified. Fig. 10. Stamen. Fig. 11. Pollen. Fig. 12. Longitudinal section of ovary. Fig. 13. Transverse section of ovary. Figs. 14, 15. Fruit. 16. Transverse section of fruit.

MNIOPSIS SELAGINOIDES, n. sp.; rhizomate minuto, squamæformi, caulibus fasciculatis erectis 1–3-pollicaribus teretibus gracilibus carnosulis, sterilibus basi nudis apicem versus folia longe filiformia 2–5-pollicaria basi semiteretia superne anguste loriformia gerentibus, fertilibus a basi squamis imbricatis triquetris acutis rigidis apice foliiferis tectis, folio cum apice squamæ persistentis articulato deciduo, floribus in caulibus squamosis terminalibus solitariis, involucro oblongo urceolato, apice bidentato, staminodiis 2, staminibus 2 monadelphis, stigmatibus 2 integris vel lobatis, capsula lævi.

In streams, up to 3000 feet; very abundant. All the leaves of this species fall off before the flowering-season (December); but the scales are persistent.

TAB. XXV. Fig. 1. Plant, natural size. Fig. 2. Branch, with scales and leaves. Fig. 3. Branch, with scaleless leaves towards apex. Fig. 4. Scale and leaf, magnified. Fig. 5. Scale after leaf has fallen off, magnified. Fig. 6. Flowering plant, natural size. Fig. 7. Apex of stem, with scales and flowers. Figs. 8, 9. Scale. Fig. 10. Involucre. Fig. 11. Involucre, opened. Fig. 12. Flower, with involucre removed. Fig. 13. Stamens. Fig. 14. Longitudinal section of ovary. Fig. 15. Transverse section of ovary.

URTICACEÆ.

LAPORTEA CRENULATA, Gaud. This dreadfully stinging plant is very common in moist woods, from 3000 to 5000 feet elevation.

LAPORTEA TERMINALIS, Wight. Common in moist forests, at no great elevation.

FLEURYA INTERRUPTA, Gaud. Common in moist forests, at no great elevation.

PILEA ANGULATA, Blume. Common in moist forests, at no great elevation.

PILEA WIGHTII, Wedd. Common in moist forests, at no great elevation.

PELLIONIA HEYNEANA, Wedd. Very abundant in moist forests, at 2000 feet elevation.

LECANTHUS WIGHTII, Wedd. Abundant on rocky hill-sides, in damp places, from 2500 to 3500 feet elevation.

PROCRIS LÆVIGATA, Blume. Moist forests, 3000 feet elevation.

ELATOSTEMA LINEOLATUM, Wight. Beds of rivers, up to 4000 feet.

ELATOSTEMA CUNEATUM, Wight. Common.

ELATOSTEMA SESSILE, Forst, δ. CUSPIDATUM. Common.

ELATOSTEMA SURCULOSUM, Wight. Common.

BOEHMERIA MALABARICA, Wedd. Common in moist woods, from 2000 to 4000 feet.

BOEHMERIA PLATYPHYLLA, Ham., var. MACROSTACHYA. Common in moist woods, from 2000 to 4000 feet.

VILLEBRUNIA INTEGRIFOLIA, Wedd. Common in moist woods, from 2000 to 4000 feet.

MOROCARPUS LONGIFOLIUS, Blume. Common in moist woods, from 2000 to 4000 feet.

POUZOLZIA INDICA, Gaud., var. TETRAPTERA. Common.

POUZOLZIA AURICULATA, Wight. Common.

POUZOLZIA CYMOSA, Wight. Rare at 4000 feet.

HYRTANANDRA HIRTA, Miquel, vars. γ. δ. ε. Common up to 3500 feet elevation.

HYRTANANDRA CAUDATA, Miq. Common up to 3500 feet elevation.

HYRTANANDRA CILIARIS, Miq. (α.). Common up to 3500 feet elevation.

HYRTANANDRA TERNATA, Miq. (α.). Common up to 3500 feet elevation.

HYRTANANDRA SCABRA, Miq. Common up to 3500 feet elevation.

One form grows to a very large shrub.

EUPHORBIACEÆ.

EXCÆCARIA OPPOSITIFOLIA, Jack. Very common up to 4000 feet, in moist forests.

DALECHAMPIA BIDENTATA, Blume. At 3000 feet elevation, on rocky hill-sides.

CLEIDION JAVANICUM, Bl. Abundant in moist forests, at 2000 feet elevation.

CROTON DRUPACEUM, Roxb. Very common up to 4000 feet elevation, both as a shrub, a scandent plant, and a tree. *C. bacciferum*, L., and *C. aromaticum*, L. (herb. Hook.), seem both to belong to this species.

CROTON OBLONGIFOLIUM, Roxb.

CROTON ARGUTUM, Heyne. Moist forests; very common at 2000 feet elevation.

CROTON HYPOLEUCOS, Dalz. Moist forests; very common at 2000 feet elevation.

There is another, undescribed species in the lower moist forests, but my specimens are only in fruit; its leaves are silvery beneath, as in *C. hypoleucos*, but it grows to a tree; there seems to be the same in the Hookerian herbarium, from Borneo, unnamed.

Blachia umbellata, Baill. Banks of rivers, 3000 feet.

Dimorphocalyx glabellus, Thw. A common tree in moist woods, at 4000 feet elevation.

Tab. XXVI. Fig. 1. Branch of female plant. Fig. 2. Female flower, detached. Fig. 3. Petal. Fig. 4. Ovary and disk. Fig. 5. Longitudinal and, fig. 6, transverse section of ovary (figs. 3–6, magnified). Figs. 7, 8. Fruit, with persistent calyx. Fig. 9. Branch of male plant. Fig. 10. Flower. Fig. 11. Corolla, opened. Fig. 12. Andræcium and calyx. Fig. 13. Stamen. Figs. 14, 15. Abnormal flower and andræcium, from a Concan specimen (figs. 10–15 magnified).

Desmostemon zeylanicus, Thw. Abundant in moist forests, at 2000 to 3000 feet.

Tab. XXVII. Figs. 1, 2. Branches of male plant, in bud and flower. Fig. 3. Bud. Fig. 4. Flower. Fig. 5. Corolla, opened. Fig. 6. Calyx and andræcium. Figs. 7, 8. Stamen. Fig. 9. Branch of female plant. Fig. 10. Bud. Fig. 11. Calyx and ovary. Fig. 12. Longitudinal section of ovary. Fig. 13. Transverse section of ovary. Fig. 14. Fruit. Fig. 15. Transverse section of fruit.

Agrostistachys Indica, Dalz. Common at 4500 feet elevation.

Epistylium cordifolium, Baill. Moist woods, at no great elevation.

Epistylium floribundum, Thw. Moist woods, at no great elevation.

Epistylium polyphyllum, Thw. Moist woods, at no great elevation.

Epistylium fimbriatum, Baill. Moist woods, at no great elevation.

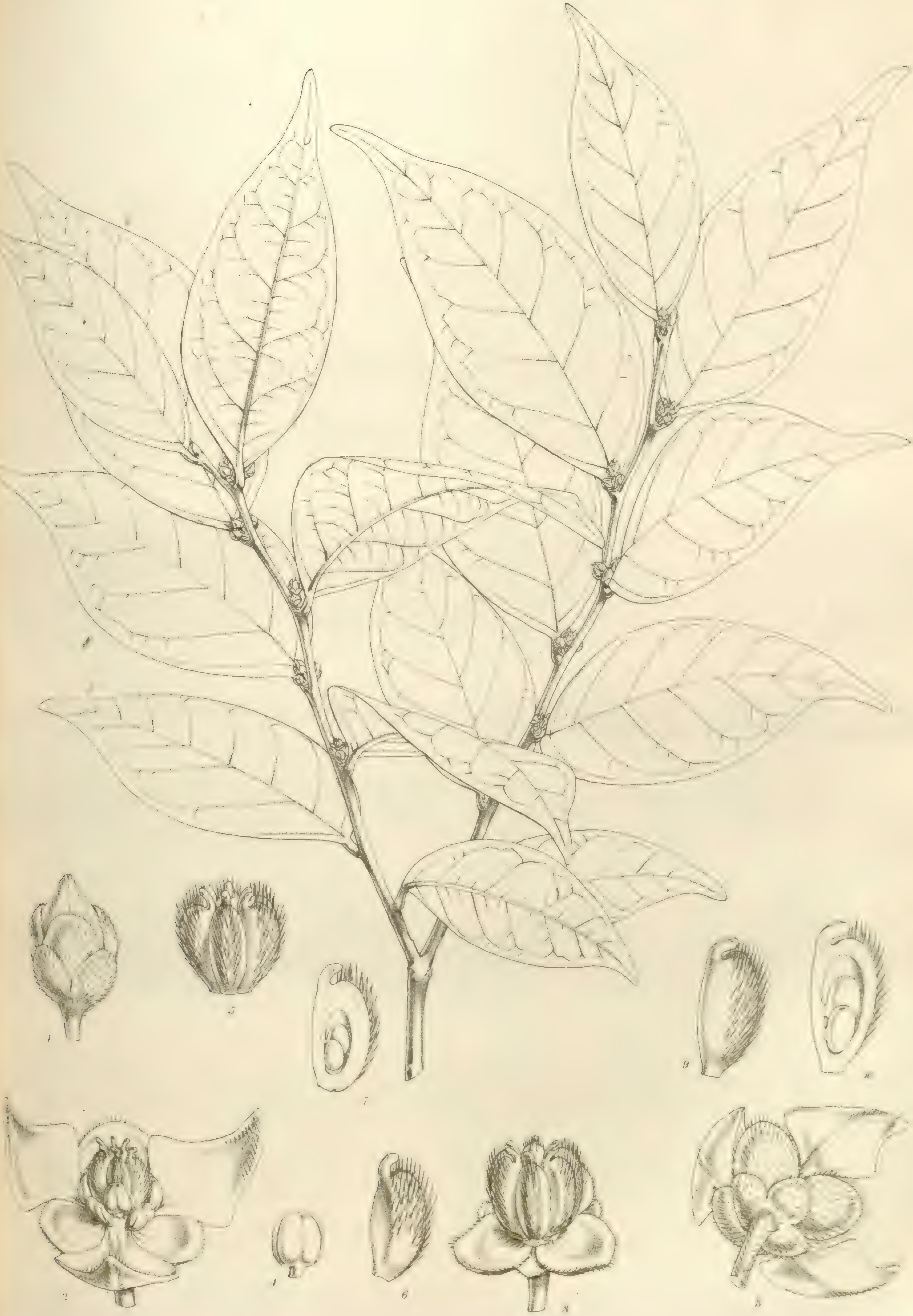
Sauropus. Two species. In moist woods, up to 4000 feet.

Pierardia macrostachys, Wight. Abundant; moist woods, up to 4000 feet. Fruit eaten by the hill tribes.

Cyclostemon zeylanicum, Thw. Very abundant in moist woods, at 2000 feet. The timber is very strong.

Hemicyclia sepiaria, W. & A. Common with the preceding.

Daphniphyllum Neilgherrense, Thw. A very common tree in moist woods, above 5000 feet.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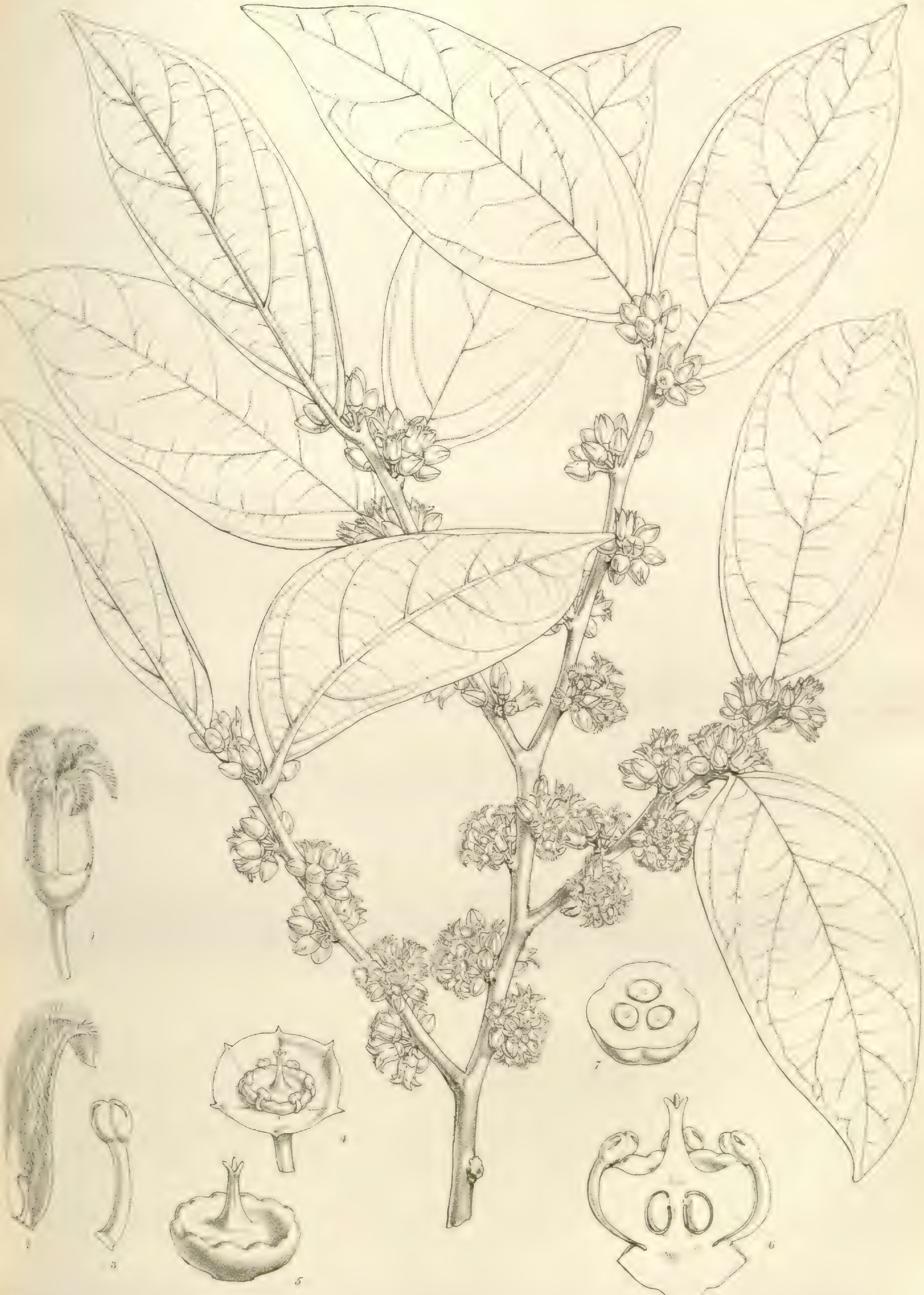
Orophea Thomsoni Bedd.



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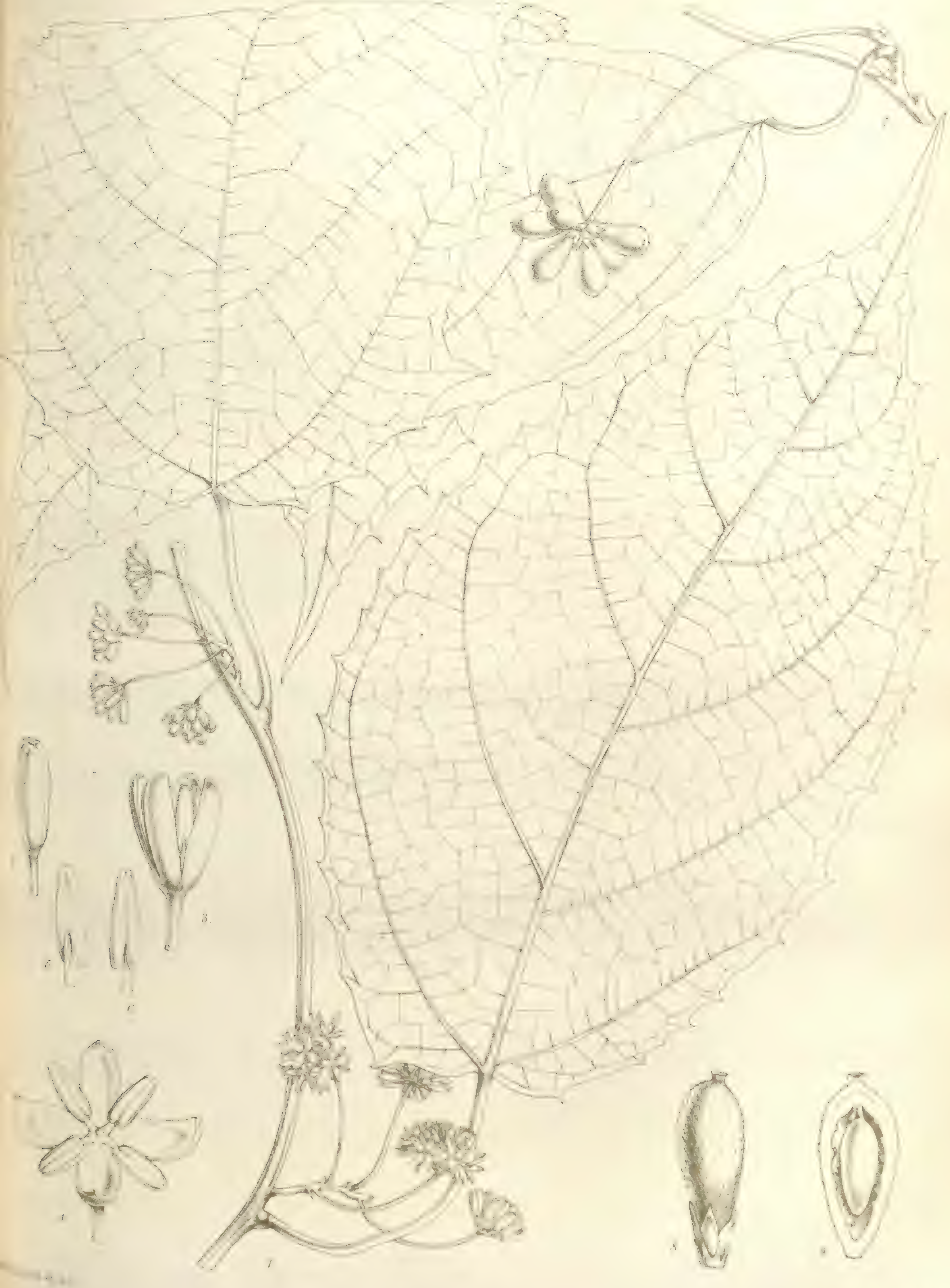
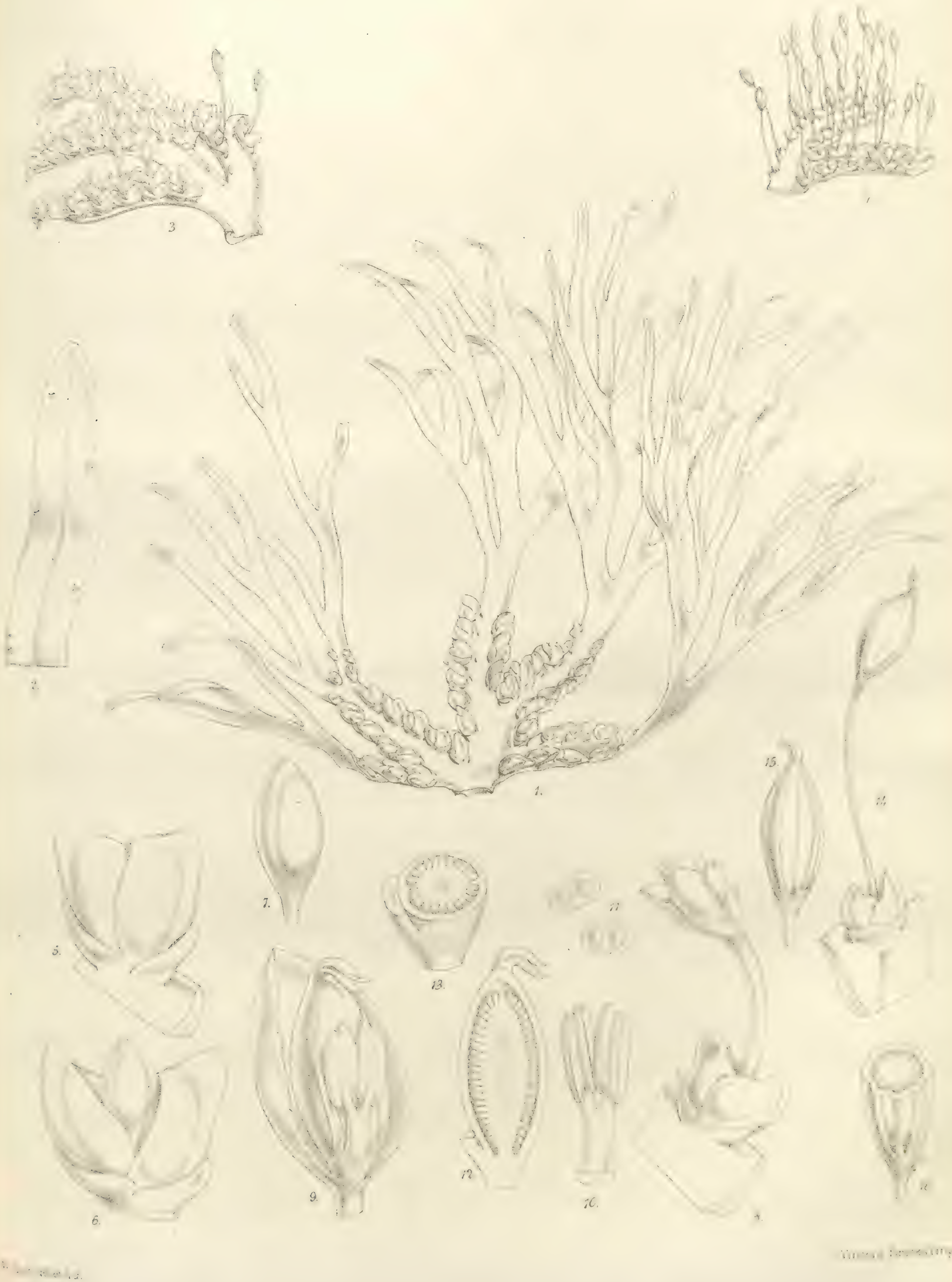
Anacolosa densiflora Bedd.



Miquelia dentata. Bedd.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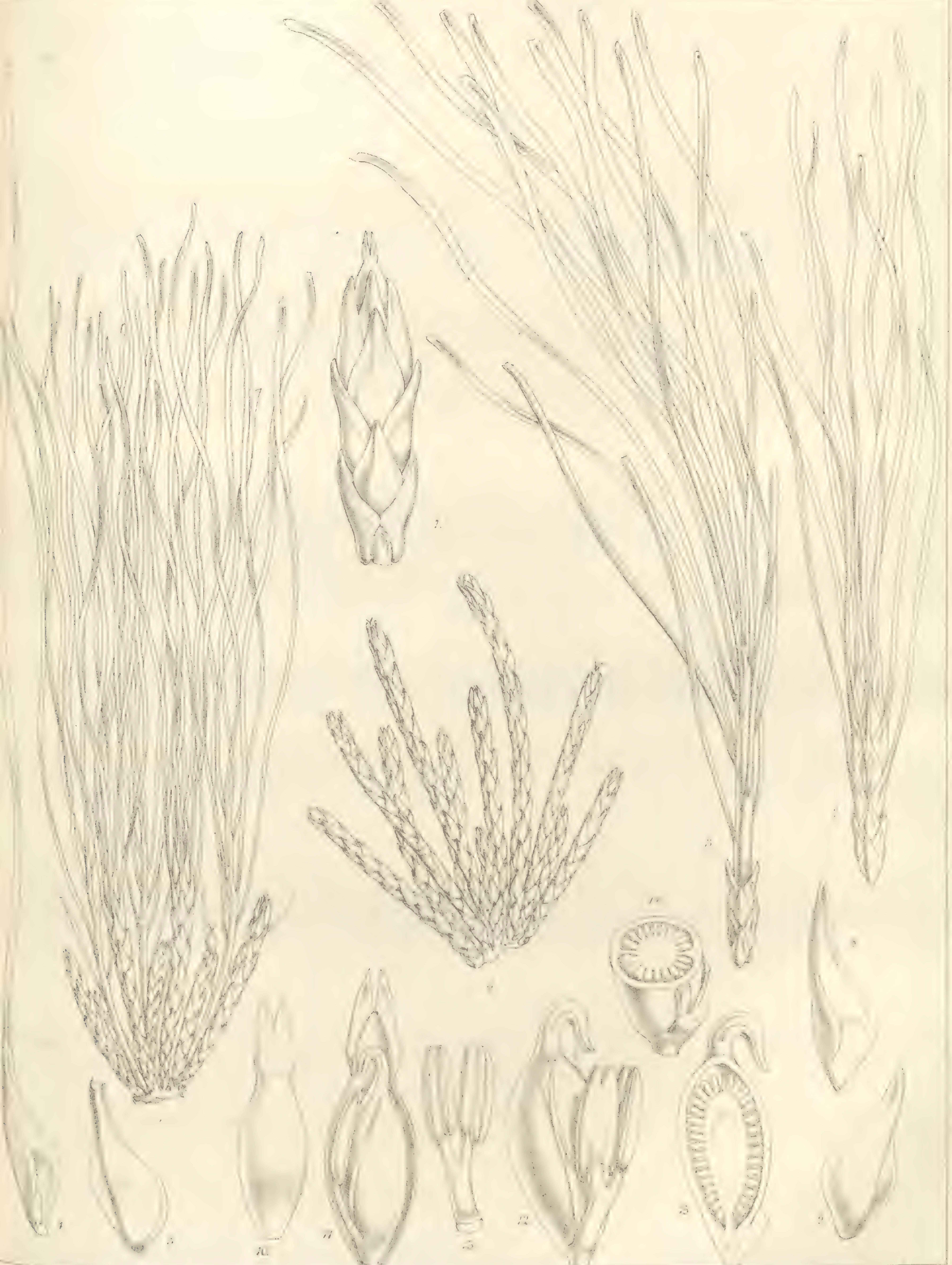
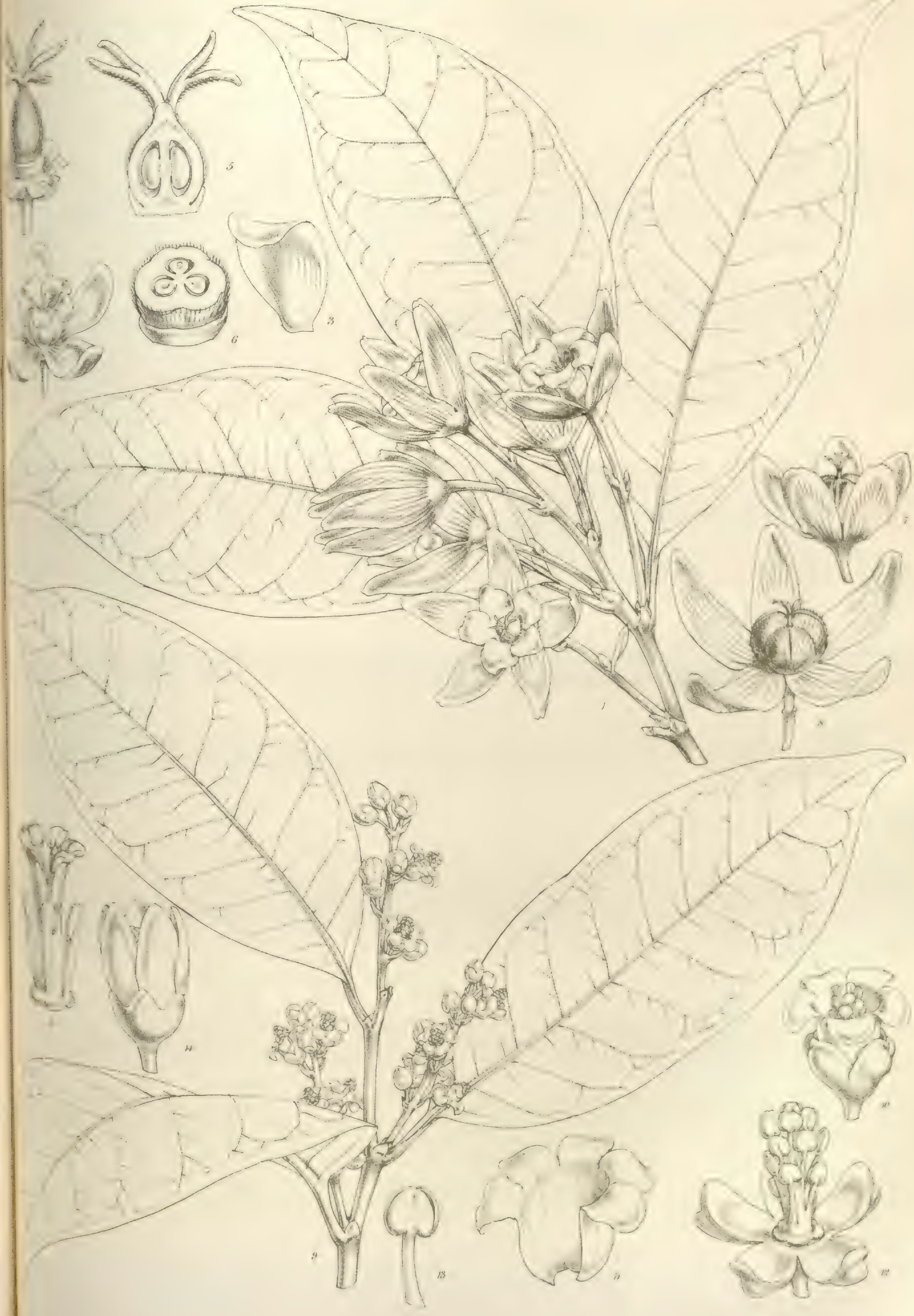
Dicræa algæformis, Bedd.



Vincent Brooks, Imp.

Mniopsis Selaginoides, Bedd.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VI. *On* Gripidea, *a New Genus of the* Loasaceæ, *with an account of some Peculiarities in the Structure of the Seeds in that Family.* *By* John Miers, *F.R.S. & L.S., Commend. Ord. Imp. Bras. Rosæ.*

(Plate XXVIII.)

Read April 20, 1865.

In the collection of plants from the interior of Brazil, made by Mr. Weir for the Royal Horticultural Society, there is a species belonging to the *Loasaceæ* so much at variance with others of that family, that it will form the type of a new genus, for which I propose the name of *Gripidea**. Its chief peculiarities consist in having only five stamens opposite each of the five larger petals, in the shape of its stigma, the structure of its capsule, and the organization of its seeds. Its large scabrid leaves, upon long petioles, are opposite, suborbicular, cordate, and divided into five unequal lobes, which are erosely denticulated. It has axillary and dichotomously ramified panicles, whose branches are furnished at their origin with nearly sessile bract-like leaflets, while a solitary flower upon a long pedicel issues from the sinus of each dichotomy. The flowers have five larger petals, which are hooded in a peculiar manner; the ovary is almost entirely inferior, leaving a short pulvinate portion above the segments of the calyx; the style is erect, and terminated by a stigma of three linear lobes, broadly fringed on their margins, the ovary itself being unilocular, with three somewhat spiral, longitudinal, sessile, placentiferous lines, upon which numerous ovules are crowded. The capsule, of thin chartaceous texture, is of a long cylindrical shape, somewhat narrower towards the base, and is crowned with the persistent reflected leaflets of the calyx, the pulvinate cap, and the remnant of the style: it is marked by numerous spiral nervures, and finally splits into three ribbon-shaped helical valves, that remain joined together at the summit and base, and which bear on their margins numerous small and almost scobiform seeds.

From these characters it will be seen that the genus belongs to the section *Helicteroides*, differing from most of the genera of that section in its adnate parietal placentæ: in this respect it approaches *Scyphanthus*; but the latter genus has a far more attenuated capsule, which opens by three teeth in the apex, and finally splits into three linear straight coriaceous valves, which separate also at the top, and thus become entirely free; the two genera are likewise at variance in the nature of their seminal integuments, the form of their embryo, the shape of their petals, the number of their stamens, in their stigma, the character of their inflorescence, and in their general habit.

Although *Caiophora* agrees with it in its capsule, which bursts along its sides into three spiral valves, adhering together at their extremities, it is at variance with it in the number of its stamens, in its stigma, but more especially in its three spiral bilamellar placentæ, which project far into the middle of the cell, thus rendering it almost 3-locular: the structure of the seed of *Caiophora* will be presently shown to be very different.

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* From γρῖπος, *rete*, εἰδέα, *forma*, because of the retiform covering of its seeds.

Blumenbachia also differs from it in many of its floral characters, but more especially in the very dissimilar shape and structure of its spiral capsule, its peculiar mode of placentation, and the development of its seeds.

The structure of the seed in *Gripidea* presents features that command attention. This, at first sight, seems as if it had a long transparent wing at each extremity; but when examined under a lens, these wings are seen to form part of a curved long cylindrical sac, pointed at both ends, with two constrictions near the middle, being five times the length and twice the breadth of a dark opake body which appears to float in its centre; this integumental sac is formed of stout cancellated bars, with large elongated and somewhat hexagonoidal spaces, formed of a thin pellicular colourless membrane, marked with small pellucid spots; there is no apparent aperture in any part of the integument, no hilar scar by which it may have been attached to the inner flotant body or to the placenta, nor the smallest trace of a duct or tracheal vessel of any kind that could form the channel of nutritory communication between the placenta and the enclosed nucleus. The seed bears much resemblance to that of *Dictyostega*, belonging to *Burmanniaceæ*, figured in the Linnean 'Transactions,' vol. xviii. pl. 37. The inner body, when removed, is found to be quite free from the integument just described; it is oval, black, opake, with a sculptured surface, formed of hexagonoidal hollows, and is terminated at its upper end by a funnel-shaped membrane, open at its apparently laciniated mouth, and formed of slender cancellated bars, with transparent spaces so finely attenuated as to vanish gradually into an almost insensible pellicle, which perhaps extends to the extremity, remaining adherent to the outer coating; but if so, it cannot be traced on account of its extreme tenuity: at its lower extremity this integument is more pointed, and vanishes in a similar manner; but we cannot perceive the smallest vestige of any raphe or chalaza either in the transparent extremities or in the thick opake middle portion of this integument; when this second coating is removed, we find a third, membranaceous, thin, translucent, reticulated coating, which closely invests the oval-shaped albumen, and which is entirely devoid of vessels; the embryo, which is nearly the length of the albumen, is quite straight, terete, with its radicle pointing upwards, the latter being somewhat longer than the two semi-cylindrical cotyledons, which are equal to it in diameter.

I expected, by the examination of ovules in their early stage of growth, that, from the greater tenuity of their membranes, some light would be thrown on this anomaly; but I was disappointed: the integuments of an ovule half advanced to maturity are similar in shape to those of the ripe seed, the outer coating is even more lax, and the inner body can be moved within it with even more facility, appearing to be quite free; the second integument, now more transparent, is expanded in a similar manner at both extremities, and under a powerful microscope no trace of any nourishing vessels can be detected, nor any scar at either extremity to denote the presence of either micropyle or chalaza.

On examining an ovary at the period of the maturity of the flower, its very numerous scobiform ovules are seen divaricately suspended from, and densely imbricated upon, the three nerve-like lines of parietal placentation: the ovule at this stage much resembles the seed in shape, but is without any constriction; the outer delicate lax integument, very elongated and attenuated at each extremity, shows in its middle an oblong body of denser texture, as before mentioned: the only circumstance worthy of note is, however, of some value, as we here ascertain the position of the hilar point of suspension, which is at the upper extremity; and from this we learn its relation to the direction of the embryo, which is not to be detected in the ripe seed taken from a capsule after desiccation.

The foregoing details naturally suggest the inquiry, What is the nature of these seminal envelopes, which, in an anatropous seed, exhibit neither a raphe nor a chalaza? I am aware that many botanists will regard this question as too trivial in its nature to merit discussion, and will consider the condition of the seminal tunics of no importance in a practical point of view, because it affords them little assistance in determining the genus or species to which any plant may belong. On the other hand, any condition of the seminal tunics at variance with the ordinary rule of development becomes a matter of extreme interest to those who have made physiological botany their study; they will, of course, endeavour to ascertain the cause of the want of the usual organic connexion between the two integuments above mentioned, as well as of the total absence of those nourishing vessels, which ordinarily extend from the placenta to the chalazal base of the seminal coatings, and which we have been taught to believe are essentially necessary to the development and growth of seeds.

There can be no doubt of the facts above stated; and it is of some importance to know that it is not a solitary instance, for I find the same circumstances repeated under still more manifest conditions in other genera of the same family. In *Bartonia*, for example, the seed is very different in form and appearance; it is orbicular, extremely compressed, with a central opake disk, surrounded by a delicately reticulated translucid wing, from a point on the margin of which it is attached to the placenta in a horizontal position. By introducing the point of a knife into the margin of this wing, and carrying it round its circumference, it becomes divided into two platter-shaped halves, thus showing the wing to be a portion of an entire, flattened, integumental sac, enclosing an opake body in the hollow of the discoidal central space, where it rests without the appearance of any attachment whatever between it and the sac; there is only a deposit of loose cellular tissue between them, in the form of opake-white granules. When viewed under a microscope, this delicate outer integument appears uniformly and finely reticulated; no vessel of any kind, no cicatrix, no trace of either raphe or chalaza, no indication of any organic connexion between it and its enclosed disk can be detected: the central disk-shaped body is formed of an extremely thin mass of albumen, covered by a colourless pellicular membrane, too delicate to be detached in an entire state; and though both are very transparent, they show no trace of vessels of any kind; were they present, they could not fail to be detected in membranes of such great tenuity. The albumen contains an embryo, with a terete radicle pointing to the remote placentary point of attachment on the margin of the seed; the cotyledons are flat and orbicular, their diameter being equal to the length, and twice the thickness, of the radicle. We may contrast this structure with that seen in *Eccromocarpus* and other Bignoniaceous genera, where the seed has an opake disk, surrounded by a broad annular membranaceous wing, as in *Bartonia*; there, a manifest hilar point is seen on the edge of the disk, not on the wing, and a distinct linear raphe extends across it, from that hilar point, till it reaches the opposite edge of the disk, at the chalazal point where the two integuments adhere together. It is quite different in *Bartonia*, where, owing to the absence of a raphe and chalaza, the inner integument floats in the centre of the outer membranaceous sac, without any visible point of attachment between them; in this case, the great transparency of the two integuments renders a mistake impossible.

A third instance of the same anomalous structure is found in *Blumenbachia*, where the outer coating of the seed is a cancellated lax integument resembling that of *Gripidea*; it is three times the length and twice the breadth of an inner oval body which is very dark and opake, and which floats in the centre of the large vacant space, without the smallest apparent organic connexion between it and the outer cancellated tunic: this inner body has a thin covering of white cellular tissue of papery consistence, though so lax as to be easily wiped off by a slight friction; beneath it, is a firmer, brown, but delicate integument, with a rugous surface, having a small depression with a minute papilla at its apex, and a scarcely perceptible mamillary projection at its base, without any scar or thickening of the integument; nor is there the slightest vestige of a raphe, which would certainly be seen if it were present, for this coating, when removed, is transparent and, as well as the others, regularly reticulated; this third integument tightly invests a fleshy albumen, which shows the same apical depression and almost imperceptible basal protuberance as in the investing tunic; it encloses an embryo with a superior terete radicle, and oblong flattish cotyledons equal to it in length and somewhat broader than it.

The seed of *Caiophora*, which has not hitherto been correctly described, presents a similar phenomenon; its outer tunic is long and cylindrical, but, unlike the former instances, it closely invests the inner integument; it is provided at its apex with a persistent black polished process, and is singularly furnished from top to bottom with about twelve broad, equal, longitudinal, radiating wings, whose breadth equals the diameter of the tunic; the cylindrical portion is transparent and regularly reticulated, but the wings are marked along their margin and at equal distances by simple transverse bars, which make as many rectangular areolar spaces, filled by a hyaline delicate membrane faintly striated by oblique and nearly parallel veins; the wall of the cylindrical portion, though quite transparent, shows no indication of a raphe. The second tunic is opakely white, as in *Blumenbachia*, and is in like manner formed of rather lax cellular tissue; it is free from the outer coating, as well as from the third integument, except at its apex, where it adheres by a point to the apical black strophiolar process before mentioned; it closely invests the third delicate reticulated brown coating, which resembles that of *Blumenbachia*, and has a minute black speck at its summit and base; but there is no sign of any nourishing vessels upon any of the three integuments. The embryo, imbedded in the axis of fleshy albumen, is long, narrow, perfectly terete, with a superior radicle somewhat longer than its cotyledons, which are equal to it in thickness.

In *Scyphanthus*, the structure of the seed is similar to that of *Loasa*, that is to say, it is anatropous, of an oval shape, with a short terminal strophiolar expansion; it is opake and deeply pitted or foveolated; and when this outer tunic is removed, the ridges which separate the external pits just mentioned are found to consist of cancellated bars, with intervening pellicular spaces, analogous to the outer integument of *Gripidea*; but, as in all the previous cases, there is no visible raphe, nor any appearance of a chalaza, either upon it or on the delicate integument which invests the albumen.

In *Raphisanthe* the seed is of an oval form, rendered trigonous by three narrow longitudinal ridges; the outer integument, as in some species of *Loasa*, is very thick, with a minutely bullated surface, being rigid and brittle, formed of numerous corneous cells, and easily softened in boiling water; it has a strophiolar projection in its apex: the inner capacity of this thick tunic has twice the length and nearly double the breadth of the inner body seen within it; this inner body is of an oblong shape, and consists of the albumen, covered by a pellicular and finely reticulated integument, with a black apical micropylar point, by which it is attached to the strophiolar process, so that it is thus suspended in the summit of the vacant space; and it has another minute dark speck at its lower extremity, which is far removed from the bottom of the cell of the outer integument—a fact of considerable importance in this inquiry; it is covered by an extremely pellicular white intermediate envelope, as in the preceding genera, but which in this instance, rather adheres to the outer tunic; this envelope, from its great tenuity, might easily escape observation. It is worthy of remark, that there is no appearance of a raphe in any of these integuments. This genus has a spiral cylindrical capsule, much resembling that of *Gripidea*; but its placentation is nearly that of *Caiophora*, that is to say, it has two lamellar seminiferous plates upon each of the three spiral lines of placentation, which nearly reach the centre of the cell. This genus differs from *Gripidea* in the from of its petals, in the number of its stamens, its placentation, and in the structure of its seeds*.

In *Ancyrostemma* and *Mentzelia* the seeds are oval; in the former, suspended by a curved strophiolar process, which looks like a transparent membranaceous funicle; their outer coating, as in *Gripidea*, is foveolated and divided by prominent bars into elongated hexagonoidal areoles, the interspaces being formed of very reticulated membrane; this coating, as in *Scyphanthus*, closely invests an extremely delicate inner integument, with much smaller square reticulations, which give it the appearance of being transversely striated, but there is no vestige of any tracheal vessels in either of these translucent tunics; upon the inner one, which is perfectly white, there is a small black spot at the apex, and one at the base so very minute as to be scarcely visible. In both genera, the embryo, shaped as in *Scyphanthus*, is imbedded in the axis of the albumen.

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* The genus *Raphisanthe* was proposed by Lilja, in 1841 (Linnæa, xv. 263), upon the *Loasa lateritia*, Hooker; but it has not been acknowledged by botanists. Klotzsch was evidently wrong in making it identical with *Caiophora*; it appears to me a valid genus. I have examined another plant, which corresponds in structure with the type, and which forms a second species, viz.—

2. ***Raphisanthe Ochagaviæ***:—Loasa Ochagaviæ, *Philippi* (Linnæa, xxviii. 641). Chile, *v. s. in herb. meo*, Cordillera de Maule (Germain).

I have been precise in the description of the seeds in all the foregoing genera, because of the uniformity in the want of a raphe in their seminal integuments, which is a feature of too remarkable a character to be passed over without special inquiry. By analogy, it must be presumed that at an early stage in the growth of the ovule, which in the *Loasaceæ* is certainly anatropous, some means must have existed for conveying the nutriment from the placenta to the base of the ovule, and for effecting, through the chalaza, the secretion of the amniotic fluid; for Mr. Robert Brown, the highest of all authorities on this subject, has shown * that the function of the chalaza is not only to assist in the nutrition of the proper membranes of the seed, but for the higher purpose of secreting the amnios, the albumen being that portion of this fluid which remains after all the rest has been absorbed in the development of the embryo. He, as well as Mirbel, who followed in the same path, showed that in an atropous ovule there is no need of a raphe; but where the ovules are more or less anatropous (or, as they have been improperly termed, inverted †), the raphe becomes the essential channel for conveying nutrition from the placenta to the chalaza, and that it uniformly belongs to the outer integument ‡; hence it followed as a rule, that any external coating of an anatropous seed, void of a raphe, must be of extraneous origin, derived generally from a growth of the placenta, or more rarely from an expansion of a caruncular swelling of the foramen of the outer proper integument, and is therefore in its nature arilloid. The enunciation of these facts as a general law, together with the disclosure of the circumstances under which the embryo-sac is evolved and fertilized, were rightly regarded as the most brilliant accession to our knowledge in modern times, and justly obtained for their great discoverer the high distinction of "Botanicorum Princeps."

Taking these facts into consideration, we must either suppose that in the original integuments of the ovule in the *Loasaceæ* a raphe once existed, which by some process of absorption has disappeared, or we must imagine that the evolution and growth of the ovule must be effected by some other functional contrivance, yet unknown, different from the ordinary laws of development. There is little in the appearance of the integuments to support the former supposition; for if we imagine the vascular cord to have disappeared, we certainly ought to perceive the vestiges of its course in the irregularity of the areoles in the reticulation of the outer coating, but no such irregularities can be discerned. Under the second supposition, I confess my inability to form any satisfactory conjecture; the only one that occurs to me is the possibility that, by some kind of capillary action, the proper nutriment may be conveyed through the cells of the lax and scarcely aggregated tissue of the intermediate pellicular coating; but this would apply only to *Caiophora*, *Blumenbachia*, and a few others, but not to *Gripidea*, where the structure of the intermediate integument is very different. On the other hand, it might be imagined that the lax intermediate coating is the vestige of the original outer tunic of the ovule, which has withered and become absorbed, while the outer seminal integument may have originated from an expansion of the foramen or of the placenta, in which case it would be an arilloid, certainly not an arillus, which is always an emanation from the chalaza: this view might be supported by the fact of the suspension of the inner body of the seed in *Raphisanthe*, and its attachment at the summit within the much larger capacity of the outer integument; but this supposition is again contradicted by the structure of the seed of *Bartonia*, where the inner body has no such organic connexion, either at the apical point of suspension or at the opposite extremity. Indeed, the whole seminal structure of the *Loasaceæ* offers an enigma which can only be solved by careful observations upon the living plants, by watching the successive growth of the ovules from their earliest stages, and tracing the channel through which nutrition is conveyed from the placenta for the secretion of the amniotic fluid, the growth of the albumen, and the perfection of the embryo.

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* Linn. Trans. x. 35.

† "On the Development of the Vegetable Ovule, called Anatropous," Ann. Nat. Hist. 3rd series, iv. 15; Contrib. Bot. i. 200.

‡ Gen. Rem. p. 55.

It may here be noticed, that Brown observed a similar anomaly in the integument of the seed in *Orchidaceæ*; he showed (Linn. Trans. vol. xvi. 710) that it is entirely without vessels, and that the funicle at its origin is never vascular, being inserted in the ripe seed upon the outer integument, close to one side of its open foramen, and can hardly be traced beyond that point. It is singular that this great botanist should have allowed this anomaly to pass without pursuing it further; but he probably abstained from this, under the idea he once evidently entertained, that this outer tunic is an arillus (Prodr. 310). It is true that he afterwards traced the growth of this tunic from its earliest pullulation, and observed its gradual and anatropous expansion (Linn. Trans. vol. xvi. 710); he there described this tunic under the name of testa, and we may perhaps ascribe his reticence concerning the cause of so unusual an occurrence in the outer tunic, to his inability to discover the structure of the opake nucleus contained within it, the nature of which, owing to its minute size, has not yet been determined. Subsequently Prof. Henfrey (Linn. Trans. vol. xxi. plate 2) figured the gradual anatropous growth of the ovule in *Orchis* up to the period of its fertilization, and he there shows the absence of tracheal vessels in the funicle, as well as in both coats of the ovule. I have noticed that in the ovary and capsule of Orchids there is an abundant supply of nourishing vessels, but they are entirely confined within the lines of placentation. I have also shown a very similar structure of the seeds in *Burmanniaceæ* (Linn. Trans. vol. xvii. plate 38, fig. 4, and in vol. xx. plate 15, figs. 17 & 18).

In all the foregoing descriptions, the use of the terms usually given to the seminal integuments has been avoided, because, in these instances, they do not exhibit the features which are universally regarded as necessary to the condition of testa and tegmen.

In reference to what has hitherto been chronicled concerning the *Loasaceæ*, it may be remarked, that numerous species of *Loasa* and its congeners have been described by botanists, but no one appears to have directed his attention to the peculiar organization of the integumental covering of their seeds; at least I can nowhere find any distinct allusion either to the existence or absence of a raphe or chalaza in the seeds of that family; the universal silence on that point tends to confirm what I have stated. In the systematic works of DeCandolle, Endlicher, Lindley, and others, it is merely said that the ovules and seeds are anatropous, with the radicle in proximity to a vertical hilum. Prof. Agardh is the only botanist who has made particular reference to this subject; but his conclusions are ambiguous, and may be questioned with much reason. He agrees with others in regard to their anatropous development; at least, he says* that the ovules of *Loasa*, *Caiophora*, and *Blumenbachia* are pendulous and "epitropous" (a term employed by him to denote an ordinary anatropous ovule with a ventral raphe, in contradistinction to his term "apotropous" where, as in *Ilex*, the pendulous ovule has a dorsal raphe†); he states, in addition, that in *Microsperma* (*Eucnide*) and in *Bartonia* the ovules are heterotropous, a term now seldom used, but which implies that the hilum, or point of its attachment, is placed midway between the micropyle and chalaza, or, in more ordinary language, amphitropous. This supposition is at variance with the drawing of the seed of *Microsperma*, given by Sir Wm. Hooker in his 'Icones,' plate 234. fig. 5; Zuccarini also says that the seed in this genus has an orthotropous embryo, with flat linear cotyledons in the axis of albumen. Prof. Agardh is equally mistaken in regard to the seed of *Bartonia*, for the structure explained in the foregoing details is quite opposed to its heterotropous development. In the work just quoted, he shows the figure of an ovule of *Caiophora* (plate 18. fig. 8), where it is anatropous, with a ventral raphe, which latter feature is not mentioned in the text; he adds another of *Loasa* (fig. 7), which is anatropous, without any indication of a raphe: in the explanation of these figures, he repeats that the ovule is nearly straight and heterotropous in *Microsperma*, curved and epitropous in *Caiophora*, adding that it is amphitropous in *Blumenbachia*, and nearly campylotropous in many species of *Loasa*. These declarations must be held doubtful, until they are supported by other authority; they are certainly not consistent with the diagnoses of the several genera of *Loasaceæ* in Endlicher's 'Genera Plantarum,' where in every case the embryo is said to be orthotropous, or only slightly curved, and anatropous, which I have found to be true in every instance that has fallen under my notice, and I have shown in the previous details that the seed is not amphitropous in *Blumenbachia*.

It may also be noticed that, in 1823, when few species of *Loasa* were known, Schrader divided the genus into two sections:—1°, where the seeds have an arillus, the radicle pointing to the hilum; 2°, where they have no aril, the hilum being lateral. I have never met with a seed in this family with a lateral hilum; one instance only occurred to me where the radicle was slightly curved, but there it still pointed to the hilum, which, correspondingly, was removed from the geometrical apex of the seed—a result which I attributed to the effect of pressure during growth.

We may hence infer, as a general rule, the exceptions to which are doubtful, that the ovules and seeds in the *Loasaceæ* are simply anatropous, with integumental coverings which have no visible raphe, that they are either horizontally attached to the placenta or suspended from it, and that the embryo is constantly orthotropous, or very slightly curved in the axis of albumen, with the radicle turned towards the hilum.

Having shown that *Gripidea* differs in many essential respects from all other genera of the family, I now proceed to enumerate its characters.

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* Theor. Syst. p. 262.

† *Ibid.* Introd. p. lxxiv.

Gripidea, gen. nov.

Calyx cylindricus, spiraliter striatus, tubo infero cum ovario connato, limbi laciniis 5, acutis, æqualibus, reflexis, persistentibus. *Petala* 10, calyce inserta; 5 majora ejus laciniis alterna, gibboso-inflata, apice obliqua, et pileolato-cucullata, imo unguiculata; 5 altera multo minora, laciniis opposita, gibboso-concava, unguiculata, ad apicem contracta, truncata et brevissime triloba, lobis reflexis, dorso triseta. *Stamina fertilia* 25, in phalanges 5 ad ungues petalorum majorum fasciculata, erecta, subinclusa; *stamina sterilia* 10, ante petala minora geminatim affixa: *filamenta* fertilium petalis æquilonga, filiformia, glabra, imo breviter latiora; sterilium ananthera, subulata, compressa, pilosa; *antheræ* minimæ, ovatæ, 2-locellatæ, rimis longitudinalibus dehiscentes. *Ovarium* subcylindricum, pro majore parte inferum, parte supera pulviniforme, 1-loculare, *placentis* 3, parietalibus, subspiraliter longitudinalibus, *ovula* plurima creberrime imbricata et subdivaricatim suspensa gerentibus. *Stylus* simplex, pilosus. *Stigma* trifidum, laciniis longiusculis, acutis, erecto-conniventibus, margine fimbriato-laceratis. *Capsula* membranaceo-testacea, elongata, cylindrica, imo paulo attenuata, calycis laciniis reflexis coronata, apice pulvine styloque apiculata, hinc demum operculatim 3-fissa, nervis plurimis eleganter striata, 1-locularis, 3-valvis, valvis circa coronam calycinam etiamque ad basin arcte cohærentibus et lateraliter apud suturas modo torsili hiantibus. *Semina* numerosissima, parva, circa margines valvarum ad placentas 3 toruloso-flagelliformes demum solutas creberrime suspensa; *integumentum externum* elongatum, crumenatum, laxissimum, fortiter reticulato-cancellatum; *tunica intermedia* multo minor, soluta, et in centro natans, crassa, foveolato-reticulata, obscura, extremitatibus laxis in pellicula tenuissima evanescentibus; *integumentum internum* simplex, tenuissimum, reticulatum, albumen arcte vestiens; *albumen* ovale, carnosum; *embryo* inclusus, paulo brevior, cylindrico-oblongus, *radicula* supera, crassiuscula, *cotyledonibus* ejusdem diametro paulo brevioribus.—Herbæ *Brasilienses scandentes, scabrido-pilosæ*; folia *opposita, exstipulata, suborbicularia, inciso-lobata, cordata, imo 5-nervia, longe petiolata*; paniculæ *axillares et terminales, basi nudæ, tandem dichotomæ*; flores *sæpius solitarii, pedicellati, in sinibus dichotomiarum orti, imo bracteis foliosis donati*; petala *majora, viridi-aurantiaca, minora rubescentia.*

1. Gripidea scabra, nob.; herbacea, ramis succulento-fistulosis, striatis, ruguloso-verruculosis, petiolisque retrorsim rigide pilosis; foliis latis, inæqualiter 5-lobis, imo profunde auriculato-cordatis, lobis acutis, subsinuatis, eroso-denticulatis, e basi 5-nerviis, utrinque scabridis et vix adpresse pilosis, supra viridibus, subnitentibus, subtus pallidioribus, opacis, petiolo limbo æquilongo, subito deflexo; paniculis oppositis, patentibus, pedunculo nudo, folium æquante, apice dichotome ramoso, ramis imo bracteatis, bracteis gradatim minoribus, foliaceis, subsessilibus, denticulatis, floribus in dichotomiis solitariis, pedicellatis. In Brasilia meridionali.—*v. s. in herb. Soc. Reg. Hort.* Corvo, inter Coritiba et sinum Paranaguá, in prov. San Paulo (Weir, no. 465).

There is little to add to the above description, and the accompanying drawing of the plant. The larger petals are greenish on the summit and back, and of a bright orange colour along the broad compressed margins; the smaller petals, considered by many as nectarial processes, are of a pale reddish colour; all the filaments are white, the fertile ones are nearly the length of the petals, and very slender; the anthers are very small, oval, of a pale yellow colour, and dorsally affixed upon a fleshy connective.

2. Gripidea asperata, nob.: *Mentzelia aspera*, Vell. (non Linn.) Fl. Flum. p. 224, Icon. vol. v. tab. 96;—herbacea, subprocumbens, ramis succulentis, pilosis; foliis

alternis, cordato-orbicularibus, acutis, lobato-incisis, lobis 5–7 subæqualibus æquilongis acutiusculis serrulato-dentatis, e basi 5–7-nerviis, utrinque asperato-hirtis, petiolo limbo subæquilongo; inflorescentia e ramulo novello aut axillari vel terminali, pedunculo bifloro, imo 2-bracteato; bracteis oppositis, sessilibus, ovatis, acutis, denticulatis; floribus breviter pedicellatis; sepalis parvis, denticulatis; staminibus 5 in quoque petalo majore absconditis; petalis minoribus multo abbreviatis; capsula elongata, turbinato-cylindrica, rigide pilosa, valvis 3 spiralibus, seminibus plurimis minutis. In Brasilia.

I have no knowledge of this species beyond the short description of Velloz and his drawing of the plant, as above quoted: it evidently belongs to this genus, agreeing in the structure of the flower, in the number of its stamens, and in the form of its capsule. The leaves are 2–2¼ inches long, 2–2¾ inches broad, with a basal sinus 3 lines deep, the petiole measuring 1¾–2 inches; the peduncle is 1 inch long, the sessile bracts 6 lines long and 5 lines broad, the pedicel about 3 lines long; the sepals 1 line long; the larger petals 5 or 6 lines long, the shorter ones 1 or 2 lines in length; the spiral capsule is 1¾ inch long, and 4 lines in diameter; it is unilocular, with numerous seeds attached to three helically longitudinal and parietal placentæ.

I may here mention that the *Mentzelia urens* of Velloz (*loc. suprà citat.* tab. 97) is the *Loasa parviflora* of Schreber, and his *Loasa urens* (*loc. cit.* tab. 98) is the *Blumenbachia latifolia* of St.-Hilaire.

EXPLANATION OF PLATE XXVIII.

Fig. 1. A portion of a plant of *Gripidea scabra* in flower and in seed: of the natural size.

Fig. 2. One of the larger petals and a fascicle of five fertile stamens.

Fig. 3. One of the smaller petals shown in three different positions, each with three dorsal setæ and two sterile stamens: all of the natural size.

Fig. 4. The ovary surmounted by the calyx, pulvinate cap, style and stigma: magnified.

Fig. 5. The same cut open, showing the three spiral lines of parietal placentation with numerous suspended ovules: magnified.

Fig. 6. One of the ovules: highly magnified.

Fig. 7. The style and stigma: much magnified.

Fig. 8. A capsule, showing its mode of dehiscence: of the natural size.

Fig. 9. One the spiral placentæ: of the natural size.

Fig. 10. The same: magnified.

Fig. 11. A seed: of the natural size.

Fig. 12. The same: magnified.

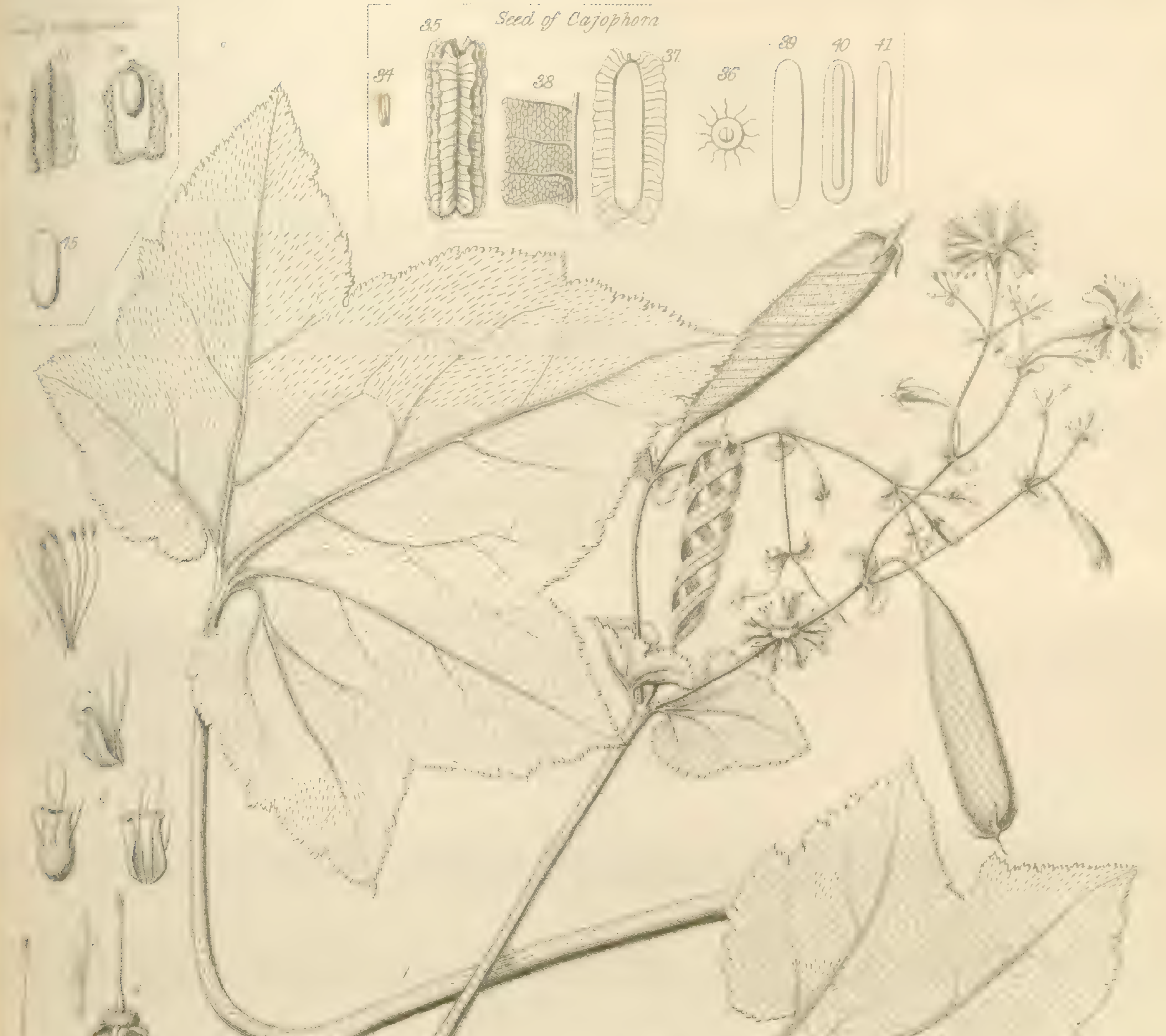
Fig. 13. The same, with half of the outer integument removed, showing the position of the free intermediate tunic and its enclosed nucleus.

Fig. 14. The same tunic and nucleus removed.

Fig. 15. The inner integument covering the albumen enclosed in the former.

Fig. 16. A longitudinal section of the albumen with the embryo imbedded in it.

Fig. 17. The embryo extracted:—all magnified on the same scale.


Seed of Cajophora
34
35
38
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33

G. Jarman sc.

Fig. 18. A seed of *Bartonia sinuata*, Presl, of the natural size.
Fig. 19. The same, magnified;
Fig. 20. The same, seen edgeways;
Fig. 21. The outer integumental sac, cut open, with the nucleus removed;
Fig. 22. The nucleus, consisting of an inner integument covering the albumen;
Fig. 23. The same, seen edgeways;
Fig. 24. The inner integument removed and cut open;
Fig. 25. The albumen containing the embryo;
Fig. 26. The embryo extracted. All magnified on the same scale.

Fig. 27. A seed of *Blumenbachia insignis*, Schrad., of the natural size.
Fig. 28. The same, magnified;
Fig. 29. The outer integument cut open and removed;
Fig. 30. The intermediate integument;
Fig. 31. The inner integument enclosing the albumen;
Fig. 32. A longitudinal section of the albumen, with the embryo imbedded in it;
Fig. 33. The embryo extracted. All magnified on the same scale.

Fig. 34. A seed of *Caiophora absinthiifolia*, Presl, of the natural size.
Fig. 35. The same, magnified;
Fig. 36. A transverse section of the same, showing the position of its wings;
Fig. 37. A longitudinal section of the same, showing the size and marking of two of the wings, the apical strophiole, and the enclosed nucleus suspended from it. All magnified on the same scale.
Fig. 38. A portion of one of the wings, showing the rectangular areoles filled with a delicate reticulated membrane more highly magnified;
Fig. 39. The inner integument covering the albumen;
Fig. 40. A longitudinal section of the albumen, in which the embryo is imbedded;
Fig. 41. The embryo extracted. All (except fig. 38) magnified on the same scale.

Fig. 42. A seed of *Raphisanthe Ochagaviæ*, nob., of the natural size.
Fig. 43. The same, magnified.
Fig. 44. A longitudinal section of the same, showing the nucleus suspended from the summit, within the much larger space of the thick outer integument, and therefore free from it at the base: also magnified.
Fig. 45. The albumen invested by the inner integument, showing the black apical point from which it is suspended, and the small dark speck on its base: more magnified.

VII. *Supplementary Observations on the* Sphæriæ *of the Hookerian Herbarium.*

By FREDERICK CURREY, *M.A.*, *F.R.S.*, *Sec. L.S.*

Read June 15th, 1865.

THE present paper is intended as a supplement to two previous communications on the same subject, published in the 22nd volume (pp. 257, 313) of the Society's Transactions; and its object is to point out which of the species there figured have been described from authentic specimens, and, with regard to the non-authentic specimens, to state by whom the plants have been named. As this paper was on the point of going to the press, Sir William Hooker's long and distinguished career was brought to a close; and I must therefore express to Dr. Hooker alone my gratitude for the liberality and kindness shown to me by his lamented father and himself in affording me every opportunity for a careful reexamination of their valuable collection. I wish also to offer my thanks to Mr. Berkeley for his obliging assistance in determining the handwriting on several of the specimens.

It will be seen upon examination of the following particulars, that the Herbarium contains a large number of authentic specimens, besides many which, without being absolutely authentic, are almost, if not quite as valuable, from having been identified by Fries, and published by him in the 'Scleromycetes Sueciæ,' or described in the 'Systema Mycologicum.' The other specimens have for the most part been named by Sir William Hooker, Mr. Berkeley, Dr. Greville, or Dr. Klotzsch, botanists whose opinions will be accepted with confidence by all mycologists.

In the 'Botanische Zeitung' for 1864, p. 189, Fries has published some "Adnotata" on some of the species described in my previous papers, which it will be useful to notice as I proceed.*

I have adopted the usual plan of placing the mark (!) against the names of those plants of which the Herbarium contains authentic specimens.

A. COMPOSITÆ.

DIV. 1. CORDYCEPS.

1. S. (CORDYCEPS) GUNNII, Berk.!

2. S. (CORDYCEPS) MILITARIS, L. Collected by Carmichael, and named by Klotzsch. There can be no doubt about this species.

3. S. (XYLARIA) PILEIFORMIS, Berk.! Mr. Berkeley considers this plant intermediate between *Cordyceps* and *Poronia*. Fries (Summa Veg. Sc. p. 382, and Novæ Symb. Myc. p. 113) speaks of it as a Poronia. Tulasne (Sel. Fung. Carp. vol. ii. p. 29) thinks it may form the type of a separate genus, and notices some points of resemblance to *Xylaria pedunculata*, Dicks.

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* Adnotata ad cel. Fr. Currey Dissertationem: Synopsis, &c.

4. S. (Xylaria) pedunculata, Dicks. A British specimen named by Berkeley.

5. S. (Cordyceps) entomorrhiza. British specimens named by Berkeley.

6. S. (Cordyceps) ophioglossoides, Ehrh. Specimens named by Mougeot and Klotzsch.

7. S. (Xylaria) involuta, Kl.!

8. S. (Xylaria) Guianensis, Mont.! (Syll. p. 202).

9. S. (Cordyceps) capitata, Holmsk.; Fr. S. M. vol. ii. p. 324. Specimens named by Mougeot.

10. S. (Hypoxylon) Cœnopus, Mont.! Fries (Adnotata) remarks, "Fons: Fr. in Linn. v. p. 542, inter Hypoxyla nec ad Xylarias."

11. S. (Xylaria) polymorpha, Pers.; Fr. S. M. vol. xi. p. 326. British specimens named by Berkeley. The measurement of the sporidia given in my former paper is wrong; it should have been 0·0008 to 0·0009 inch.

12. S. (Hypoxylon or Poronia) Heliscus, Mont.! (Syll. p. 209.)

13. S. (Hypoxylon) rhopaloides, Mont.!

14. S. (Hypoxylon) crenulata, Berk.! Decades, no. 484. This seems a true Hypoxylon; but the fructification is very unusual, for in that genus the sporidia are unilocular.

15. S. (Xylaria) digitata, Pers.; Fr. S. M. vol. ii. p. 326. Specimens named by Mougeot.

16. S. (Xylaria) Hypoxylon, L.; Fr. S. M. vol. ii. p. 327. There are many specimens of this in the Herbarium. It is a species as to which there can be no doubt.

17. S. (Xylaria) microceras, Mont.!

18. S. (Xylaria) multiplex, Kunze. Named by Klotzsch.

19. S. (Xylaria) corniformis, Mont.! Fries (Adnotata) remarks, "Fons: Fr. Elench. ii. p. 37, Summ. Veg. Scand. Montagnei forma, ad hanc relata, videtur species diversa."

20. S. (Xylaria) ianthino-velutina, Mont.! (Syll. p. 204).

21. S. (Xylaria) carpophila, Pers.; Fr. S. M. vol. ii. p. 328. Described, I think, from a specimen given me by Mr. Berkeley. The one in the Herbarium has no fruit.

22. S. (Cordyceps) alutacea, Pers. Collected by Mr. Broome at Rudloe in Wiltshire, and named by Mr. Berkeley. Fries (Adnotata) remarks, "In Summ. Veg. Sc. hanc speciem inter Cordicipites et Hypocreas intermediam esse monui; illarum receptaculum, forma, vegetatio, harum asci et sporæ. Nonnullas examinans exoticas *Fracidias* (S. V. Sc. p. 382) quæ genus a Xylariis omnino autonomon sistunt, cum his plane convenire observavi; differt modo colore lætiore, ut *Cordiceps militaris* ab *ophioglossoide*. Fracidiæ plures æque molles et fragiles ac *F. alutacea*."

23. S. (Hypoxylon) Sagræana, Mont. This is a Cuba specimen from Kunze, but I have compared it with an authentic specimen from Dr. Montagne.

24. S. (Cordyceps) purpurea, Fr.

25. S. (CORDYCEPS) MICROCEPHALA, Tul. I have described this and the last plant from my own specimens. The species cannot be mistaken.

26. S. (CORDYCEPS) ROBERTSII, Hook. !

26 *a*. S. (CORDYCEPS) TYPHINA, Pers.; Fr. S. M. ii. p. 553. Described from my own specimens. It is a well-known species. Fries (Adnotata) remarks, "Valde lætamur cel. Auctorem hujus nexum cum Cordicipitibus confirmasse. In statu vigente *semper, verticalis,* et asci et sporæ omnino *C. militaris.* !"

Div. 2. PORONIA.

27. S. (PORONIA) PUNCTATA, Sow. Swan River specimens named by Berkeley.

Div. 3. PULVINATÆ.

28. S. (HYPOXYLON) MULTIFORMIS, Fr. S. M. ii. p. 334 ! Scleromycetes Sueciæ, n. 44.

29. S. (HYPOXYLON) DURISSIMA, Schweinitz. Klotzsch has marked this "S. durissima, *Sz.*;" but it is marked *S. annulata*, by Schweinitz himself. The species only differs from *S. multiformis*, Fr., in the *annulato-marginate* disk at the apex of the perithecia, and it may be doubted whether this is a sufficient specific distinction. The character cannot be seen without a lens.

30. S. (HYPOXYLON) FRAGIFORMIS, Pers.; Fr. S. M. ii. p. 332. From the Scleromycetes Sueciæ, nos. 41 B. and 41.

31. S. (HYPOXYLON) ANNULATA, Mont. (β. *depressa*), Mont. ! (Sylloge, p. 213). Fries (Adnotata) remarks, "Fons est Fr. Elench. ii. p. 64, c. var.; cfr. Nov. Symb. Myc."

32. S. (HYPOXYLON) CONCENTRICA, Bolt.; Fr. S. M. ii. p. 331. Named by Klotzsch.

33. S. (HYPOCREA) GELATINOSA, Tode; Fr. S. M. ii. p. 336. This is the fructification in a specimen from Tunbridge Wells in my own herbarium, and in one from Massachusetts given me by Mr. Bloxam. All the Kew plants are barren.

34. S. (HYPOXYLON) VERNICOSA, Schwein. Named by Berkeley.

35. S. (HYPOXYLON) ARGILLACEA, Fr. Obs. i. t. 2. f. 5. Named by Berkeley.

36. S. (HYPOCREA) RUFA, Pers.; Fr. S. M. ii. p. 335. Named by Klotzsch. The plants look black to the naked eye, but under a lens the red tinge of the fresh condition is quite perceptible.

37. S. PRUINATA, Kl. Linn. vol. viii. p. 489. Marked "*S. farinosa,* n. sp." by Klotzsch. Quære if identical with *S. pruinata*, Kl.?

38. S. (HYPOXYLON) FUSCA, Pers.; Fr. S. M. ii. p. 332. From the Scleromycetes Sueciæ, No. 42.

39. S. (HYPOXYLON ?) PARMULARIA, Berk.; from the Fungi Pyrenæi. The plant marked *Sphæria parmularia* by Mr. Berkeley is certainly an Hypoxylon, and, I think, not distinct from *S. cohærens*, P.; but there seems to have been some mistake; I suspect that the label of this plant belongs to no. 167 *post*, and *vice versâ.*

40. S. (Hypoxylon) cohærens, Pers.; Fr. S. M. ii. p. 335. From the Scleromycetes Sueciæ, no. 43.

41. S. (Hypoxylon) rubricosa, Fr. El. ii. p. 63. Named by Berkeley. I doubt if this plant is rightly named; but it is sometimes difficult to distinguish between *Hypoxylon cohærens*, *H. multiforme*, and *H. rubricosum*.

Div. 4. Connatæ.

42. S. (Hypoxylon) rubiginosa, Pers.; Fr. S. M. ii. p. 340. From the Scleromycetes Sueciæ, no. 142. The sporidia are sometimes curved in a side view.

43. S. (Hypoxylon) atro-purpurea, Tode; Fr. S. M. ii. p. 340. From the Scleromycetes Sueciæ, no. 75.

44. S. (Hypoxylon) perforata, Schwein.! Fr. S. M. ii. p. 340.

45. S. botryosa, Fr. S. M. ii. p. 342! From the Scleromycetes Sueciæ.

46. S. (Hypocrea) lateritia, Fr. S. M. ii. p. 338. These specimens are from Mr. Stephens's herbarium. In Rabenhorst's 'Fungi Europæi,' no. 317, the sporidia are the same except that in most the endochrome is bipartite, giving them a uniseptate appearance. I see no reason now to think that they become brown in age, as suggested in my former paper.

47. S. (Hypoxylon) serpens, Pers.; Fr. S. M. ii. p. 341. From the Scleromycetes Sueciæ, no. 47.

48. S. (Hypocrea) hyalina, Schwein.! Fr. S. M. ii. p. 339.

49. S. (Hypoxylon) Sassafras, Schwein.! Fr. S. M. ii. p. 343.

50. S. (Hypocrea) citrina, Pers.; Fr. S. M. ii. p. 337. Named by Schweinitz.

51. S. (Hypocrea) lobata. Named by Schweinitz. Fries (Adnotata) remarks, "*Sph.* s. *Hypocrea lobata*, Schwz.; minime vero Wormskj. et Fr. S. M. Est *Hypocrea Schweinitzii*, Fr. El. ii. p. 60, c. synon. supra citato."

52. S. (Hypocrea) luteo-virens, Fr. S. M. ii. p. 339. From a specimen named by Mr. Broome. The Kew plants have no fruit. I doubt whether *Hypocrea luteovirens*, Fr., *S. lateritia*, Fr., and *S. lactifluorum*, Schwein., are not all one species.

Div. 5. Glebosæ.

53. S. (Hypoxylon) repanda, Fr. S. M. ii. p. 346! From the Scleromycetes Sueciæ, no. 1.

54. S. (Hypoxylon) tubulina, A. and S.; Fr. S. M. ii. p. 346. From the Scleromycetes Sueciæ, no. 341. I think this is a Diatrype, not an Hypoxylon.

55. S. (Hypoxylon) lutea, A. & S.; Fr. S. M. ii. p. 347. Figured from plants in my own herbarium named by Berkeley, but which are certainly the same as *S. tubulina*, suprà.

56. S. (HYPOXYLON) DEUSTA, Hoffm.; Fr. S. M. ii. p. 345. From the Scleromycetes Sueciæ, no. 261.

57. S. (HYPOXYLON) FUSCOSPORA, Schwein.!

58. S. (HYPOXYLON) NUMMULARIA, Bull.; Fr. S. M. ii. p. 348. Named by Klotzsch.

59. S. (HYPOXYLON) MARGINATA, Fr. El. ii. p. 69. Figured from South Carolina specimens given me by Mr. Berkeley. It is not, I think, distinct from *S. annulata*, suprà., of which it seems to be a small form.

DIV. 6. LIGNOSÆ.

60. S. (HYPOXYLON) UDA, Pers.; Fr. S. M. ii. p. 358. Figured from plants in my own herbarium, which agree externally in every respect with a specimen from the Scleromycetes Sueciæ, no. 324. I could not have dissected the latter without injury.

61. S. (DIATRYPE) DISCIFORMIS, Hoffm.; Fr. S. M. ii. p. 353. From the Scleromycetes Sueciæ, no. 71.

62. S. (DIATRYPE) FLAVOVIRENS, Hoffm.; Fr. S. M. ii. p. 357. From the Scleromycetes Sueciæ, no. 222.

63. S. (DIATRYPE) PLATYSTOMA, Schwein.! Fr. S. M. ii. p. 351. Upon reconsideration, the points of distinction between this and *S. stigma*, Hoffm., mentioned in my former paper are hardly reliable. Fries's specimen of *S. stigma* has a rimose stroma, and the ostiola do not differ substantially from those in the latter species.

64. S. (HYPOXYLON) VOGESIACA, Pers. in litt. Sent by Persoon to Mougeot.

65. S. (HYPOXYLON) VIRGULTORUM, Fr.! S. M. ii. p. 351, El. ii. p. 71.

66. S. (DIATRYPE) ATRO-PUNCTATA, Schwein.! Fr. S. M. ii. p. 351.

67. S. (DIATRYPE ?) RHOIS, Schwein.! Fr. S. M. ii. p. 356.

68. S. (DIATRYPE) LIRIODENDRI, Schwein.! Fr. S. M. ii. p. 356.

69. S. (DIATRYPE) CAPNODES, Berkeley!

70. S. (HYPOXYLON) MELANASPIS, Mont.! Sylloge, p. 215.

71. S. (DIATRYPE) DRYOPHILA, Curr.!

72. S. (DIATRYPE) NUCLEATA, Curr.!

73. S. (DIATRYPE or VALSA) VARIANS, Curr.!

74. S. (DIATRYPE or VALSA) DENIGRANS, Curr.!

75. S. (DIATRYPE) INÆQUALIS, Curr.!

76. S. (DIATRYPE) BADHAMI, Curr.!

77. S. (DIATRYPE) VERRUCÆFORMIS, Ehr.; Fr. S. M. ii. p. 355. Drawn from specimens in my herbarium, which agree externally with a plant from Scleromycetes Sueciæ, no. 74, in the Hookerian herbarium. The latter has no fruit. Very different things have been published under the name of *S. verrucæformis*. M. Duby tells me that

his specimens from the Scleromycetes Sueciæ, no. 74, have elliptical dark-coloured sporidia, and that Desm. Exs. ed. 1, 1272, is the same.

78. S. (DIATRYPE) FAVACEA, Fr. S. M. ii. p. 354.

79. S. (DIATRYPE) ASPERA, Fr. S. M. ii. p. 354. From plants named by myself. I have seen no other specimens.

80. S. (DIATRYPE) STIGMA, Hoffm.; Fr. S. M. ii. p. 350. From the Scleromycetes Sueciæ, no. 46.

81. S. (DIATRYPE) BULLATA, Ehr.; Fr. S. M. ii. p. 349. From the Scleromycetes Sueciæ, no. 46.

82. S. UNDULATA, Pers.; Fr. S. M. ii. p. 350. Named by Berkeley.

83. S. (HYPOCREA) LENTA, Schwein.! Fr. S. M. ii. p. 349. The name "Tode," after this plant in my former paper is a mistake. *S. lenta*, Tode, seems distinct from *S. lenta*, Schwein. I do not know the former plant. Fries (Adnotata) remarks, "*Sph.* s. *Hypocrea lenta*, Schwz. Non Tode et Fr. S. M., quæ *Diatrypes* species. Est *S. rigens*, El. ii. p. 61, ubi hanc et præcedentem inter *Hypocreas* descripsi, et in S. V. Sc. has duas species expressis verbis ad *Hypocreas* retuli. Nullus igitur exstat inter nos de harum loco systematico dissensus."

Div. 7. VERSATILES.

84. S. (DIATRYPE) SCABROSA, Dec.; Fr. S. M. ii. p. 360. Named by Berkeley, but it is certainly *S. pulvis-pyrius*, Pers. The size of the fruit is only rather larger than usual.

85. S. (DIATRYPE) PODOIDES, Pers. Syn. p. 22, excl. syn. Named by Mougeot. Probably received by him from Persoon, as the next certainly was.

86. S. PODOIDES, var. LÆVIS, Pers.! in litt. to Mougeot.

87. S. (DIATRYPE?) PETIGINOSA, Fr.! in litt. to Mougeot.

88. S. (DIATRYPE) LEPROSA, Pers.! Fr. S. M. ii. p. 365.

89. S. (DIATRYPE) STRUMELLA, Fr.! S. M. ii. p. 365. From the Scleromycetes Sueciæ, no. 115. The curvature or non-curvature of the sporidia probably depends upon the aspect in which they are viewed.

90. S. (DIATRYPE) RADICALIS, Schwein.! Fr. El. ii. p. 73.

91. S. (DIATRYPE) QUERCINA, Pers. This plant and no. 170 *post* (*Valsa arcuata*), are probably the same, and quite distinct from *S. quercina*, Pers., which is closely allied to, even if it be distinct from, *S. verrucæformis*, Ehrh. See the supposed distinctions pointed out by Tulasne, in Sel. Fung. Carp. vol. ii. p. 99.

92. S. (DIATRYPE) LANCIFORMIS, Fr.! S. M. ii. p. 362. From the Scleromycetes Sueciæ, no. 73.

93. S. (DIATRYPE) HYSTRIX, Tode; Fr. S. M. ii. p. 364. Named by Berkeley, but he has since said that the specimen here described, which is an Italian plant from De Notaris, is not *S. Hystrix*. See Ann. Nat. Hist. May, 1859.

94. S. (Diatrype) ceratosperma, Tode; Fr. S. M. ii. p. 364. Named by Berkeley. This is a little-known species. M. Duby has remarked to me concerning it, "Species admodum controversa. Tot auctores tot specimina." Tulasne considers the plant here described to be *S. ceratosperma* of Mougeot and Nestler, and that *S. ceratosperma* of Tode, "fortassis non longe recedat." See Sel. Fung. Carp. vol. ii. p. 191.

95. S. (Diatrype) ferruginea, Pers.; Fr. S. M. ii. p. 363. From the Scleromycetes Sueciæ, no. 305.

96. S. (Diatrype) nigerrima, Bloxam, MS.! This plant belongs to the *Cæspitosæ*. See Mr. Berkeley's remarks in Ann. Nat. Hist. May, 1859.

97. S. (Diatrype) irregularis, Sow. "*S. gastrina*," Fr. is in Mr. Berkeley's handwriting; but it is doubtful whether the two are identical.

98. S. (Diatrype) Mougeotii, Pers.! in litt. to Mougeot. Fries (Adnotata) remarks, "*Sph.* s. *Diatrype Mougeotii* non est *Sph. Mougeotii*, Fr. El. p. 100, sed meo sensu, var. *Sph. Hystricis*, El. p. 74."

Div. 8. Concrescentes.

99. S. fibrosa, Pers.; Fr. S. M. ii. p. 384. The specimens at Kew have no fruit. A plant in my herbarium, given me by Mr. Berkeley, has the fruit here described. It seems to be the same thing as *S. extensa*, no. 119 *post.*

100. S. depressa, Fr.; Montagne, Sylloge, p. 232!

101. S. parallela, Fr. S. M. ii. p. 373! Scleromycetes Sueciæ, no. 3.

102. S. (Diatrype) leioplaca, Fr.! S. M. ii. p. 370.

103. S. fimeti, Pers., var. *equina*. Named by Montagne. Fries (Adnotata) remarks, "Ex ascis et loco fingimus hanc pertinere ad *Sph. equinam*, Fr. apud Mont. et S. V. Sc., quæ a *Sph. fimeti* plane diversa.

104. S. (Diplodia) Diospyri, Schwein.! Fr. S. M. ii. p. 372.

105. S. velata, Pers.; Fr. S. M. ii. p. 375. From the Scleromycetes Sueciæ, no. 225.

106. S. (Diatrype) discincola, Schwein.! Fr. S. M. ii. p. 368.

107. S. (Diatrype) milliaria! Fr. S. M. ii. p. 370. From the Scleromycetes Sueciæ, no. 113.

108. S. (Sphæria) limæformis, Schweinitz! Fr. S. M. ii. p. 369.

109. S. (Sphæria) spinosa, Pers.; Fr. S. M. ii. p. 368. I am uncertain from which specimen this was described. There are several in the herbarium, but I could find no fruit on reexamination except in one named by Klotzsch, which does not quite agree with the description here. Tulasne agrees with Fries in considering *S. limæformis*, Schwein., hardly different from *S. spinosa*, Pers.

110. S. elevata, Berk.!

111. S. (Diatrype) lata, Pers.; Fr. S. M. ii. p. 369. Named by Klotzsch.

112. S. (SPHÆRIA) SPICULOSA, Pers.; Fr. S. M. ii. p. 369. Named (I think) by Klotzsch.

113. S. (VALSA) MONADELPHA, Fr. S. M. ii. p. 382. Named by Berkeley.

114. S. (DIATRYPE OF VALSA) ÆQUILINEARIS, Schwein.! Fr. S. M. ii. p. 374.

115. S. (SPHÆRIA) DISCUTIENS, Berk.! Engl. Fl. p. 245.

116. S. STIPATA, Currey, Phil. Trans. 1857. This is identical with *S. dissepta*, Fr. I have since compared it with an authentic specimen from the Scleromycetes Sueciæ, and with authentic specimens given me by Dr. Montagne and M. Duby.

Div. 9. CIRCUMSCRIPTÆ.

117. S. (VALSA) ENTEROLEUCA, Fr. S. M. ii. p. 381. Named by myself. I have seen no authentic specimens.

118. S. (VALSA) ANOMIA, Fr. S. M. ii. p. 381; El. ii. p. 77. Named by Berkeley. It is, perhaps, a sphæropsoid state of *S. profusa*, Fr. A plant in the Hookerian Herbarium, marked by Klotzsch *S. anomia*, is *S. profusa*; and Tulasne considers the two identical. See Sel. Fung. Carp. vol. ii. p. 160.

119. S. (VALSA) EXTENSA, Fr. The only specimens are named by Berkeley. I could find no fruit on reexamination; but my own specimens agree exactly in fruit with this.

120. S. (VALSA) DETRUSA, Fr.! S. M. ii. p. 382. From the Scleromycetes Sueciæ, no. 6. I think the endochrome is normally bipartite.

121. S. (VALSA) PRUNASTRI, Pers.; Fr. S. M. ii. p. 380. Described from specimens named by Mougeot and Berkeley.

122. S. (VALSA) CARPINI, Pers.; Fr. S. M. ii. p. 384. Named by Berkeley.

123. S. (VALSA) SYNGENESIA, Fr. S. M. ii. p. 382. Named by Berkeley. It is marked "*S. Frangulæ*, Pers. in litt.," by Mougeot, which is identified with *S. syngenesia* by Fries in the 'Elenchus,' vol. ii. p. 78.

124. S. (VALSA) STELLULATA, Fr. Syst. Myc. ii. p. 380. From the Scleromycetes Sueciæ.

125. S. (DIPLODIA?) JUGLANDINA, Schwein.! Fr. S. M. ii. p. 385. This, by a misprint, is called *S. juglandicola* in my former paper.

Div. 10. INCUSÆ.

126. S. (VALSA) ANGULATA, Fr. S. M. ii. p. 390. There has been great confusion about this plant and *S. taleola*. Fries has published different things under the name of *S. angulata*. There is a specimen in the Hookerian Herbarium from the Scleromycetes Sueciæ, named *S. angulata*, which has no asci, and elliptical dark-brown sporidia 0·0003 inch long. Tulasne, on the other hand, describes (Sel. Fung. Carp. vol. ii. p. 101) *S. angulata* as having fruit like *S. verrucæformis*. I am quite satisfied to abide by the opinion of Messrs. Berkeley and Broome and Tulasne, according to whom *this* plant is *S. taleola*, Fr., and no. 128 *post* is *S. leiphæmia*, Fr.

127. S. (VALSA) MELASPERMA, Fr. ! S. M. ii. p. 389. From the Scleromycetes Sueciæ, no. 157.

128. S. (VALSA) TALEOLA, Fr. S. M. ii. p. 390. See remarks under *S. angulata*, no. 126 *suprà*.

129. S. (VALSA) FULVO-PRUINATA, Berk. !

130. S. (VALSA) NIVEA, Hoffm. ; Fr. S. M. ii. p. 386. From the Scleromycetes Sueciæ, no. 76. Tulasne says (S. F. Carp. vol. ii. p. 183) that he has never seen polysporous asci. In the Kew specimens all the asci are so.

131. S. (VALSA) FORAMINULA, Pers. ! in litt. to Mougeot.

132. S. (VALSA) PROFUSA, Fr. ! S. M. ii. p. 392. From the Scleromycetes Sueciæ.

133. S. (DIPLODIA ?) RUDIS, Fr. ! El. ii. p. 98. Sent by Fries to Mougeot.

134. S. (VALSA) MICROSTOMA, Pers. ; Fr. S. M. ii. p. 388. From the Scleromycetes Sueciæ, no. 185.

135. S. (VALSA) DISSEPTA, Fr. ! S. M. ii. p. 392. I originally described this from a specimen named by Dr. Montagne ; but I have since found fruit in Fries's own specimens in the Hookerian Herbarium, and the plant proves to be identical with my *S. stipata*.

136. S. (VALSA) CIRCUMSCRIPTA, Fr. ! Mont. Syll. p. 220, under "Valsa." From Dr. Montagne's herbarium.

137. S. (VALSA) KUNZEI, Fr. S. M. ii. p. 388. Named by Berkeley.

138. S. (VALSA) CONCAMERATA, Curr. !

139. S. CINCTA, Curr. ! Fries (Adnotata) remarks, "Cfr. homonyma, S. M. ii. p. 387."

140. S. (VALSA) SORBI, Schmidt, Fr. S. M. ii. p. 380. This plant is marked by Mougeot "*Sphæria acutangula*, Pers.," and by Klotzsch "*An Sphæria Sorbi*, Fr." Fries (Adnotata) remarks, "*Sph.* s. *Valsa Sorbi* sine dubio ad *Sph. circumscriptas* referenda."

141. S. (VALSA) SACCULUS, Schwein. ! Fr. S. M. ii. p. 378.

142. S. ENTEROXANTHA, Berk. ! Decades, no. 110.

143. S. (VALSA) CRATÆGI, Curr. ! The sporidia in this *Sphæria* are sometimes constricted in the centre.

144. S. (VALSA) DRYINA, Curr. !

Div. 11. OBVALLATÆ.

145. S. (VALSA) CORONATA, Hoffm. ; Fr. S. M. ii. p. 395. Tulasne says that the plant here figured hardly differs from *S. leiphæmia*, Fr. ; and I think he is right. (See his remarks as to this and as to *S. coronata*, Hoffm., in S. F. Carp. vol. ii. p. 191.)

146. S. (VALSA) LEIPHÆMIA, Fr. ! Syst. Myc. ii. p. 399. From the Scleromycetes Sueciæ, no. 78.

147. S. (VALSA) AMBIENS, Pers. Syn. p. 44 ; Fr. S. M. ii. p. 403. From the Scleromycetes Sueciæ, no. 8.

148. S. (Valsa) turgida, Pers.; Fr. S. M. ii. p. 400. From the Scleromycetes Sueciæ, no. 262, under the name of *S. faginea*, P. It is called *S. turgida* in the 'Summa Veg. Sc.' p. 412, no. 37.

149. S. (Valsa) stilbostoma, Fr. S. M. ii. p. 403. The specimen at Kew from the Scleromycetes Sueciæ has no fruit; but the figure I have given here is confirmed by Tulasne (Sel. F. Carp. vol. ii. 120). The fruit of the variety *Platanoides* (fig. 140*a*) is drawn from no. 186 of the Scleromycetes Sueciæ.

150. S. (Valsa) querna, Curr.!

151. S. (Valsa) biconica, Curr.!

152. S. (Valsa) pulchra, Curr.!

153. S. (Valsa) suffusa, Fr.! S. M. ii. p. 399. From the Scleromycetes Sueciæ, no. 229.

154. S. (Valsa) Juglandis, Schwein.! (non Fries).

155. S. (Valsa) Abietis, Fr. S. M. ii. p. 398. This plant is probably not distinct from *S. ambiens*, Pers. (See some remarks by Tulasne in 'Sel. Fung. Carp.,' vol. ii. p. 190.)

156. S. (Valsa) tetraspora, Curr.! Tulasne (S. F. Carp. vol. ii. p. 176), does not consider the tetrasporous fructification sufficient to separate this from *Valsa ambiens*, Pers.

157. S. (Valsa) salicina, Pers.; Fr. S. M. ii. p. 401. The fruit here figured is not that of *S. salicina*, Pers., but of *S. salicella* Fr., as I have ascertained from authentic specimens. There is an authentic specimen of *S. salicina*, Pers., in the Hookerian herbarium, but it is only in a cytisporoid state. *S. salicina*, Fr., has fruit like that of *Valsa ambiens*, Fr., from which it is probably not distinct.

158. S. (Valsa) intexta, Curr.!

Div. 12. Circinatæ.

159. S. (Valsa) pulchella, Pers.; Fr. S. M. ii. p. 406. I made a mistake here. Figs. 150–152 belong to some other species, probably to *S. Wahlenbergii*, Desm. The specimen of *Valsa pulchella* in the Hookerian herbarium is from the Scleromycetes Sueciæ, no. 146. The fruit is not quite perfect, but is clearly the same plant as one in my own herbarium, of which fig. 153 represents the fruit. (See Tulasne's remarks in Sel. F. Carp. vol. ii. pp. 109, 120.)

160. S. (Valsa) furfuracea, Fr. S. M. ii. p. 409. Named by myself, but I have some doubt about the species. I have seen no authentic specimens.

161. S. (Valsa) convergens, Tode; Fr. S. M. ii. p. 410. Named by Berkeley.

162. S. (Valsa) hypodermia, Fr.! S. M. ii. p. 407. From the Scleromycetes Sueciæ, no. 32.

163. S. (Valsa) thelebola, Fr.! S. M. ii. p. 408. Figs. 157 and 159 from the Scleromycetes Sueciæ, no. 384. Possibly fig. 158 is a different species, as suggested by Tulasne.

164. S. (VALSA) XANTHOSTROMA (or CHRYSOSTROMA), Fr.! Summ. Veg. Sc. p. 412, no. 32; Montagne Syll. p. 221. From the Scleromycetes Sueciæ, no. 444. The other specimen here referred to is from Dr. Montagne's herbarium.

165. S. (VALSA) VESTITA, Fr.! S. M. ii. p. 410. From the Scleromycetes Sueciæ, no. 230.

166. S. (DIPLODIA?) MELIÆ, Schwein.! Fr. El. ii. p. 85.

167. S. (VALSA), ? sp. (See observations under no. 39 *suprà*.)

168. S. (VALSA) QUATERNATA, Pers. Syn. p. 45, Fr. S. M. ii. p. 409. From the Scleromycetes Sueciæ, no. 9.

169. S. (VALSA) INNESII, Curr.!

170. S. (VALSA) ARCUATA, Curr.! I think this is the same species as no. 91 *suprà*. (See the remarks there made.)

171. S. (VALSA) FAGINEA, Curr.!

Div. 13. CÆSPITOSÆ.

172. SPHÆRIA CUPULARIS, Pers.; Fr. S. M. ii. p. 416. I cannot say whether the fruit here figured is really that of *S. cupularis*, Pers. There are specimens in the Herbarium marked as this species both by Mougeot and Berkeley; but they differ from one another, and moreover each specimen contains two different species.

173. S. PSEUDOBOMBARDA, Mont.! Sylloge, p. 228.

174. S. (NECTRIA) EXAMINANS, Berk.!

175. S. (NECTRIA) COCCINEA, Pers.; Fr. S. M. ii. p. 412. I am uncertain whether this is the true *S. coccinea*, Pers. This plant and the variety "*sanguinella*" are named by Mr. Berkeley. There is a specimen in the Herbarium from the Scleromycetes Sueciæ (no. 183) in which the asci are stuffed with myriads of minute sporidia about 0·00012 inch long.

176. S. (NECTRIA) CINNABARINA, Tode; Berk. Engl. Flora, no. 77, under "Sphæria." Figured from a fresh specimen. The species is too well known to admit of any doubt.

177. S. (NECTRIA) DECOLORANS, Pers. Syn. p. 49. From the Scleromycetes Sueciæ, no. 184. I think Fries is right in uniting it with *S. cinnabarina*, Tode. He remarks (Adnotata), "*Sph*. s. *Nectria decolorans* est status senilis *Sph. cinnabarinæ*, Tode."

178. S. BERBERIDIS, Pers.; Fr. S. M. ii. p. 415. From the Scleromycetes Sueciæ, no. 35.

179. S. (NECTRIA) CUCURBITULA, Tode; Fr. S. M. ii. p. 415. I cannot say whether this is the true *N. cucurbitula*, Tode. There is no authentic specimen of that species in the Herbarium. There are specimens named by Klotzsch and Berkeley, and from the Scleromycetes Sueciæ, no. 263, but they do not agree in fructification.

180. S. LABURNI, Pers. Syn. p. 50; Fr. S. M. ii. p. 413. From the Scleromycetes Sueciæ, no. 34.

181. S. PULICARIS, Fr. S. M. ii. p. 417. From the Scleromycetes Sueciæ.

182. S. (Nectria) Purtoni, Grev.! Fries remarks (Adnotata), "*Sph.* s. *Nectria Purtoni*=*Sphæria episphæria* in *Valsa Abietis* parasitans e specc. a cel. Greville missis. Cfr. El. ii. p. 79."

183. S. (Nectria) acervalis, Moug.! Fr. El. ii. p. 83.

184. S. (Nectria) Aquifolii, Fr.! El. ii. p. 82. Sent by Fries to Mougeot.

185. S. Sphæria acervata, Fr. S. M. ii. p. 416. I presume this was described from some specimen lent to me; for I cannot find the plant in the Hookerian herbarium, nor do I possess any specimens of it.

186. Sphæria conglobata, Fr. The specimens are named by Klotzsch and Sir W. Hooker, but I am satisfied they are all forms of *S. pulvis-pyrius*. Klotzsch and Sir W. Hooker appear to have been mistaken; for Fries remarks (Adnotata), "*Sph. conglobata* vera, meo sensu, species distincta."

187. S. Buxi, Curr.! Milton, Northamptonshire, *Berkeley*.

Div. 14. Confluentes.

188. Sphæria scoriadea, Fr.! El. ii. p. 87. From the Scleromycetes Sueciæ, no 344.

189. Sphæria rhizogena, Berk.!

190. Sphæria Spartii, Nees; Fr. S. M. ii. p. 424. From the Scleromycetes Sueciæ, no. 234. This seems to be the same as *S. elongata*, Fr.!, Scleromycetes Sueciæ, no. 33, although the sporidia of this latter plant are rather shorter, not so acuminate, and not constricted. Fries remarks (Adnotata), "*Sph. Spartii* nexus cum *S. elongata* (speciei forma primaria) manifestus sed ostiolo aliisque notis secedit. Ad genus *Cucurbitaria* Not. pertinent *Sph. Laburni, Berberidis, elongata*, '*variæ*,' *Spartii*."

191. Sphæria? Dothidea, Fr. (? Mont.) S. M. ii. p. 423. Figured from plants named by Sir Wm. Hooker and Klotzsch. There are authentic specimens from the Scleromycetes Sueciæ agreeing externally with those named by Sir Wm. Hooker and Klotzsch, but exhibiting no fruit.

192. Sphæria mutila, Fr.! S. M. ii. p. 424. From the Scleromycetes Sueciæ, no. 164. Fries (Adnotata) remarks, "Sporas semper uniseptatas vidimus."

193. Sphæria megalospora, Mont.! Sylloge, p. 229.

194. Sphæria insidens, Schwein.!

195. Sphæria melogramma, Pers.; Fr. S. M. ii. p. 420. From the Scleromycetes Sueciæ, no. 441, and specimens named by Mougeot. Fries (Adnotata) remarks, "*Sph. melogramma*=*Melogramma campylosporum*, S. V. Sc. Vidimus aliam formam stylosporam."

196. Sphæria Calycanthi, Schwein.! Fries, S. M. ii. p. 441.

197. S. (Diatrype) decipiens, Dec.; Fr. S. M. ii. p. 371. Figured from specimens named by Mr. Berkeley.

198. S. (DIPLODIA) SUBSOLITARIA, Schwein. ! F. El. ii. p. 86.

198*a*. SPHÆRIA CHRYSENTERA, Curr. !

Div. 15. SERIATÆ.

199. S. JUNCI, Fr. There are several specimens in the Herbarium from the Scleromycetes Sueciæ, others named by Sir W. Hooker, and others by Mr. Berkeley, but all in a very bad condition; I am uncertain from which this figure was drawn.

200. SPHÆRIA ARUNDINACEA, Sow. Named by Berkeley.

201. SPHÆRIA NEBULOSA, Pers.; Fr. S. M. ii. p. 450. Named by Berkeley, but agreeing with barren specimens from the Scleromycetes Sueciæ, no. 197. The sporidia in the ascus (fig. 201) are perhaps a little too much curved.

202. SPHÆRIA GODINI, Desm. Named by Berkeley.

203. SPHÆRIA CLARA, Curr. !

204. S. PARDALOTA, Mont. ! The specimens of this are imperfect. It is not the plant described in the Sylloge, although it may be an imperfect state of it. On reexamination, I found the stylospores smaller than the measurement here given.

205. SPHÆRIA ? PANTHERINA, Berk. !

206. SPHÆRIA LONGISSIMA, Pers. The specimens of this species are from the Scleromycetes Sueciæ, no. 184, and from Dr. Montagne's herbarium, but they are imperfect.

Div. 16. CONFERTÆ.

207. SPHÆRIA BIFRONS, Schm. and Kunze; Fr. S. M. ii. p. 438. Named by Mougeot.

207*a*. SPHÆRIA GRAMINIS, Pers.; Fr. S. M. ii. p. 434. Described from a fresh specimen named by myself. It is difficult to say what is the true *S. Graminis*, Pers. Fries's specimens in the Hookerian herbarium (Scler. Suec. no. 284) differ from this, which agrees, however, with specimens from Decandolle's Fl. Fr., no 779.

208. S. (DIPLODIA ?) MALORUM, Berk. ! Engl. Flora, vol. v. "Fungi," p. 257.

209. S. GIGANTEA, Mont. Syll. 230 !

210. S. (HENDERSONIA ?) YUCCÆ-GLORIOSÆ, Schwein. ! Fr. S. M. ii. p. 437.

211. SPHÆRIA RHYTISMOIDES, Bab. in Proc. Linn. Soc. vol. i. p. 32. Named by Mr. Bloxam.

212. S. (DIATRYPE) INSULARIS, Berk. MS. !

213. SPHÆRIA FIMBRIATA, Pers. Syn. p. 36; Fr. S. M. ii. p. 436. Upon reexamination, I found ripe specimens. Figure 212 is quite right. The sporidia are uniseriate or biseriate, colourless, sometimes curved, sometimes ellіptico-acuminate, sometimes with a nucleus at each end, 0·0004 inch long.

214. S. CEUTHOCARPA, Fr. S. M. ii. p. 439. Named by Mr. Broome. Fries (Adnotata) remarks, "Sporæ ex icone auctoris quam maxime a genuinis *Sphæriis* recedunt, nec tales videre unquam mihi contigit. Ex icone omnino peculiare genus = *Ceuthocarpa*."

B. SIMPLE SPHÆRIÆ.

Div. 17. BYSSISEDÆ.

215. S. GLIS, Berk. and Curr. !

216. S. DESMAZIERI, Berk. and Br. ! Ann. and Mag. Nat. Hist. 2 ser. vol. ix. p. 318, pl. 9. fig. 1.

217. S. (NECTRIA) ROSELLA, A. and Schw. ; Fr. S. M. ii. p. 441. Marked by Greville "*Sphæria rosella*, Carm. ;" by Klotzsch ! "A. and Sz."

218. S. AQUILA, Fr. S. M. ii. p. 442. Named by Berkeley. There are no authentic specimens, but there is no doubt about the species.

219. S. TRUNCATA, Schw. ! Fr. S. M. ii. p. 442. This specimen has no fruit. I think it is certainly not distinct from *S. aquila*, Fr., although the perithecia are mostly truncate, having a flattened area round the ostiolum.

220. S. FULVA, Fr. El. ii. p. 90. Named by Berkeley. Fries (Adnotata) remarks, "*Sph. fulva*=*Nectria fulva*, Fr. S. V. Sc. p. 387. Vellem attenderent auctores species *l. c.* in nota citatas non minus quam in textu allatas *Nectrias* a me esse dictas, quibus addendæ *N. agnina*, *erubescens* (Rob.), aliæque."

221. S. (NECTRIA) AURANTIA, Pers. ; Fr. S. M. ii. p. 440. Marked by Greville "*Sphæria aurantia*, Carm. ;" by Klotzsch "Pers. !" It is on *Polyporus versicolor*, Fr.

222. S. THELENA, Fr. S. M. ii. p. 441. Marked "*S. aquila*" by Klotzsch, and *S. thelena* by Berkeley. One mark of distinction between *S. aquila* and *S. thelena* is, that the subiculum in *S. aquila* is persistent, in *S. thelena* evanescent. Fries (Adnotata) remarks under *S. thelena*, "Hæc, sensu Todeano, ad Villiferas, *S. aquila* ad Pulverulentas ejusd. ; illa enim villum floccosum, album, hæc pulverem atrum eructat. Perithecia *S. thelenæ* tenuia, fragilia, *S. aquilæ* rigida, bicorticata, firam. Hinc valde diversa censeo."

223. S. LANATA, Fr. S. M. ii. p. 442. Named by Berkeley, but marked "*S. ossea*, Carm.," by Sir Wm. Hooker. The collapsed appearance of the perithecia arises from the bark covering the lower part of them. Fries (Adnotata) remarks, "A reliquis diversissima nec ad Byssisedas referenda. Semper sub cortice latet. In villo expanso primo observantur guttulæ fluxiles, limpidæ, absque perithecio (analogæ cum Myxotricho), quo tenerrimo dein obducuntur, siccitate arcte collabente. Ascos non vidi ; modo sporas subtiles, fusiformes, pellucidas."

224. S. SUBICULATA, Schwein. !

225. S. ALLIGATA, Fr. ! S. M. ii. p. 445. From the Scleromycetes Sueciæ, no. 342.

226. S. TRISTIS, Tode ; Fr. S. M. ii. p. 444. From the Scleromycetes Sueciæ. The sporidia are mostly rather rounded at the ends than acuminate.

227. S. PHÆOSTROMA, Mont. Fl. Alg. t. xxvi. fig. 2. Described from fresh British specimens. There can be no doubt about the species.

Div. 18. VILLOSÆ.

228. S. SCABRA, Curr. !

229. S. CANESCENS, Pers.; Fr. S. M. ii. p. 448. Specimens named by Sir Wm. Hooker, Klotzsch, and Berkeley; all agree.

230. S. RACODIUM, Pers.; Fr. S. M. ii. p. 449. Named by Berkeley. There is a specimen from the Scleromycetes Sueciæ, but it has no fruit.

231. S. OVINA, Pers.; Fr. S. M. ii. p. 446. Named by Berkeley.

232. S. CÆSIA, Carm.! Named by Klotzsch, who, I suppose, received it in MS. from Carmichael. From a note on the specimen, Klotzsch seems to have considered it a young state of *S. ovina*; but the fructification is totally different. Mr. Berkeley has written "an vera *Sph.*?" He had probably not examined the fruit.

233. S. HIRSUTA, Fr. S. M. ii. p. 449. Named by Klotzsch.

234. S. RHODOCHLORA, Mont.! Syll. p. 227.

235. S. MUTABILIS, Schwein.!

236. S. PILOSA, Pers.; Fr. S. M. ii. p. 440. There are four specimens, all named by Klotzsch. Three of them are as here described. The fourth has perithecia more densely hairy, but not otherwise externally distinguishable. In this latter the sporidia are very dark-brown, varying from reniform to globular (mostly the latter). The *diameter* of the globular sporidia is 0·0004 to 0·0005 inch, which is the same as the *length* of the reniform sporidia.

237. S. (CERATOSTOMA) CHIONEA. Fr.! S. M. ii. p. 446, El. vi. p. 92. From the Scleromycetes Sueciæ. Fries remarks (Adnotata), "In statu ascigero pulcherrima, sporis nigris in asco pellucido biserialibus."

238. S. STRIGOSA, A. and S.; Fr. S. M. ii. p. 448. Specimens named by Klotzsch and Mougeot. There is an authentic specimen from Schweinitz which seems to be the same thing, but it is in very bad condition.

239. S. BRASSICÆ, Kl.! Eng. Fl. p. 261. Fries (Adnotata) remarks, "Synonymon antiquius est *S. olerum*, Fr. El. p. 99. *Sph. Brassicæ* P. aliena est."

240. S. PULVINULUS, Berk.!

241. S. SUPERFICIALIS, Curr.!

242. S. CAPILLIFERA, Curr.!

Div. 19. DENUDATÆ.

243. S. INSPERSA, Berk.!

244. S. RHODOMPHALOS, Berk.! Fries (Adnotata) remarks, "Hujus synonymon est *S. rhodopis*, Fr. S. V. Sc. p. 389."

245. S. BOMBARDA, Batsch; Fr. S. M. ii. p. 456. Specimens named by Berkeley and Montagne. There is another from the Scleromycetes Sueciæ, no. 266, but shrivelled, and without fruit.

246. S. MORIFORMIS, Tode; Fr. S. M. ii. p. 458, El. ii. p. 94. From the Scleromy-

cetes Sueciæ. The asci are not always so broad as in fig. 30. The length of the sporidia is 0·0014 inch.

217. S. PUSTULA, Curr.!

218. S. PULVIS-PYRIUS, Pers.; Fr. S. M. ii. p. 458. From the Scleromycetes Sueciæ, no. 120. The specimen is marked as a variety, but I do not see in what it differs from the typical form.

219. S. CONGLOBATA, Fr. S. M. ii. p. 414. There are several specimens, all named by Klotzsch. *S. Aceris,* Pers. in litt. to Mougeot, is the same thing.

250. S. DIOICA, Fr.! Marked by Mougeot, who received it in a letter from Fries.

251. S. MOROIDES, Curr.!

252. S. PLATEATA, Pers.! in litt. to Mougeot. Fries (Adnotata) remarks, "*Sph. plateata* Pers. in litt. est *Sph. obducens* Fr. S. M. et Exs. *Sph. obducens* Schum.! est forma *Sph. spermoidis.*"

253. S. SPERMOIDES, Hoffm.; Fr. S. M. ii. p. 457. From the Scleromycetes Sueciæ, no. 237.

254. S. MAMMÆFORMIS, Pers.; Fr. S. M. ii. p. 455. Named by Greville and Klotzsch.

255. S. STERCORARIA, Sow.; Fr. S. M. ii. p. 455. Named by Berkeley.

256. S. STERCORARIA, Sow. var.?!

257. S. STERCORARIA, Fr.! S. M. ii. p. 455. Sent by Fries to Mougeot.

258. S. BIFORMIS, Schwein.! non Fries.

259. S. VERRUCOSA, Grev.! Fr. Index Alphabeticus; = *S. moriformis,* Tode. The sporidia have more than one septum, but this is probably the case with *S. moriformis.*

260. S. PULVERACEA, Ehrh.; Fr. S. M. ii. p. 459. Sent by Persoon to Mougeot. I could find no asci on reexamination. Rabenhorst's ('Fungi Europæi') no. 338 quite agrees with my description; but the sporidia reach 0·0005 inch, or nearly so.

261. S. SORDARIA, Fr.! S. M. ii. p. 458, El. ii. p. 94. From the Scleromycetes Sueciæ, no. 270.

262. S. OBDUCENS, Schum. (= *S. plateata,* Pers. *suprà*). From the Scleromycetes Sueciæ, no. 119. *S. obducens minor,* Fr. Syst. Myc. ii. p. 456: see the remarks under No. 252 *suprà.*

263. S. POMIFORMIS, Pers. From the Scleromycetes Sueciæ, no. 236. Tulasne (Sel. Fung. Carp. vol. ii. p. 246) is mistaken in supposing that I considered there was no distinction between this species and *S. pulvis-pyrius,* Pers. All I meant to say was, that the specimens marked "*pomiformis*" in the Hookerian herbarium are identical with *S. pulvis-pyrius.* Tulasne (*l. c.*) describes the sporidia of *S. pomiformis* as white, shortly ovate, and bipartite; and Fries (Adnotata) observes, "a *Sph. pulv. pyrio* vera nimis distat peritheciis primitus mollibus, regulariter collabentibus ostiolo mammæformi eumorpho."

264. S. (NECTRIA) PEZIZA, Tode; Fr. S. M. ii. p. 452. Named by Berkeley.

265. S. (**Nectria**) **sanguinea**, Fr.! From the Scleromycetes Sueciæ, no. 264.

266. S. (**Nectria**) **Episphæria**, Tode; Fr. S. M. ii. p. 454, El. ii. p. 94. Named by Berkeley. This is a well-known species.

267. S. **rubicola**, Curr.!

268. S. (**Gibbera**) **Vaccinii**, Sow. t. 373. fig. 1; Eng. Flora, vol. v. pt. 2. p. 254. There are specimens from the Scleromycetes Sueciæ, no. 51, and others named by Mougeot. I do not recollect which specimen the fruit is drawn from, as I could find none on reexamination. The two are clearly the same thing.

269. S. **caudata**, Curr.!

270. S. **collabens**, Curr.!

271. S. **Curreyii**, Blox. MS.!

272. S. **pulviscula**, Curr.!

Div. 20. Pertusæ.

273. S. **pertusa**, Pers.; Fr. S. M. ii. p. 464. Specimens named by Klotzsch and Sir Wm. Hooker.

274. S. **picastra**, Fr.! S. M. ii. p. 463.

275. S. (**Diplodia**) **lecythea**, Schwein.! Fr. S. M. ii. 460.

276. S. **merdaria**, Fr.! El. ii. p. 100. Sent by Fries to Mougeot.

277. S. **Olearum**, Cast. From Desmazière's herbarium, Pl. Cr. de Fr. no. 1767.

278. S. **ulmicola**, Curr.!

279. S. **micraspis**, Berk.!

280. S. **putaminum**, Schwein.!; Fr. S. M. ii. p. 461.

281. S. **callicarpa**, Curr.!

Div. 21. Platystomæ.

282. S. **barbara**, Fr. S. M. ii. p. 468. Specimens named by Montagne and Berkeley.

283. S. **macrostoma**, Tode; Fr. S. M. ii. p. 469. From the Scleromycetes Sueciæ, no. 345. It is *S. media*, Pers., of which there is an authentic specimen. *S. diminuens*, Pers., of which there is a specimen from the Scleromycetes Sueciæ, no. 447, seems to be the same thing.

284. S. **ligniaria**, Grev. Sc. Cr. Fl. t. 82. Named by Sir Wm. Hooker. Probably received by him from Dr. Greville. Fries observes (Adnotata), "*Sph. ligniaria* Grev.! ex meis specc. non ad Lophiostomas pertinet."

285. S. **cristata**, Pers.,=*S. crenata*, Fr. S. M. ii. p. 469. Named by Mougeot.

Div. 22. Ceratostomæ.

S. **brevirostris**, Fr.! S. M. ii. p. 474. From the Scleromycetes Sueciæ, no. 790.

287. S. **longispora**, Curr.! The name *S. rostellata* is in Klotzsch's handwriting.

288. S. (CYTISPORA), MICULA Fr.! El. ii. p. 101. Sent by Fries to Mougeot.

289. S. (SPHÆROPSIS?) PILIFERA, Fr.! S. M. ii. p. 472. From the Scleromycetes Sueciæ, no. 25.

290. S. CIRRHOSA, Fr. Both plants mentioned under this number are named by Klotzsch. I find the perithecia of the latter tomentose, and the sporidia colourless, on re-examination. An authentic specimen from the Scleromycetes Sueciæ is quite decayed.

291. S. ROSTRATA, Fr. S. M. ii. p. 473. Named by Klotzsch, with a ?. It is marked *Sphæria parabolica* by (I think) Carmichael.

Div. 23. OBTECTÆ.

292. S. EUTYPA, Fr. S. M. ii. p. 478. Named by Berkeley. A specimen from the Scleromycetes Sueciæ, no. 15 (obviously the same species), has no fruit.

293. S. VIBRATILIS, Fr. S. M. ii. p. 482. See the observations in my former paper.

294. S. OPERCULATA, A. and S.; Fr. S. M. ii. p. 479. From the Scleromycetes Sueciæ, no. 268. Fries (Adnotata) remarks, "Præter statum hujus aliarumque ascigerum alium legi nucleo omnino *Sph. acutæ*! Prorsus similem in *Diatrype disciformi* quoque vidimus. Lætamur cel. auctorem etiam *Sph. acutam* genere haud movendam censere."

295. S. (HALONIA) CUBICULARIS, Fr. S. M. ii. p. 477, El. ii. p. 97. Named by Montagne.

296. S. LIVIDA, Fr. S. M. ii. p. 479. From the Scleromycetes Sueciæ, no. 516.

297. S. (SPHÆROPSIS) PRUINOSA, Fr. S. M. ii. p. 486. There are two specimens—one from the Scleromycetes Sueciæ, without fruit, the other named by Mougeot.

298. S. (SPHÆROPSIS?) OLEÆ, DC.; Fr. S. M. ii. p. 489. Named by Persoon.

299. S. (HERCOSPORA) RHODOSTOMA, A. & S.; Fr. S. M. ii. p. 485. From the Scleromycetes Sueciæ, no. 83.

300. S. CERASARUM, Fr.!

301. S. TAMARISCI, Grev.! (not "Tamariscinis" as in the text).

302. S. PINASTRI, Dec.; Fr. S. M. ii. p. 488. From the Scleromycetes Sueciæ, no. 190.

303. S. CLYPEATA, Nees; Fr. S. M. ii. p. 487. Named by Klotzsch. It is doubtful whether or not *S. clypeata* is a state of *S. mamillana*, Fr. I suspect it is; for I see something like septa in the sporidia; and if the sporidia of *S. clypeata* were septate, it could hardly be separated from *S. mamillana*. Fries evidently doubts their distinctness: see 'Syst. Myc.' ii. p. 487.

304. S. XYLOSTEI, Pers.; Fr. S. M. ii. p. 487, El. ii. p. 99. From the Scleromycetes Sueciæ, no. 189. I think the sporidia lose their border in age.

305. S. (HENDERSONIA) MAMILLANA, Fr. S. M. ii. p. 487. From the Scleromycetes Sueciæ, no. 397, marked "*minor*." In a specimen of *S. mamillana*, Fr. (Desm. Fl. Cr. de France, edit. i. 1279), given me by M. Desmazières, I find long slender asci, containing narrowly oblong, slightly curved, 3-septate, brown sporidia, 0·0007 to

0·0009 inch long, uni- or bi-seriate, mostly the former. This is, no doubt, the perfect state of the species, the Kew specimen being only imperfectly developed.

306. S. (HENDERSONIA) HIRTA, Fr.! S. M. ii. p. 483. From the Scleromycetes Sueciæ, no. 17.

307. S. SEMIIMMERSA, Grev.!

308. S. OCELLATA, Fr.! S. M. ii. p. 480. From the Scleromycetes Sueciæ, no. 187.

309. S. TOMICUM, Lev. Ann. des Sc. Nat. 1848. From Desmazière's Fl. Cr. de France, no. 1776!

310. S. CONFORMIS, Berk. & Br.! Ann. and Mag. Nat. Hist. ser. 2. vol. ix. p. 325, pl. xi. fig. 19.

311. S. (HALONIA) DITOPA, Fr. S. M. ii. 381. Drawn from a specimen given to me by Mr. Broome. The one in the Hookerian herbarium, from the Scleromycetes Sueciæ, no. 84, has no fruit. Tulasne (S. F. Carp. ii. p. 145) makes *S. ditopa* a myriasporous form of *S. suffusa*, Fr. I cannot understand this, for no two things could be more unlike one another in fructification.

312. S. QUADRINUCLEATA, Curr.!

313. S. RUBI, Curr.!

314. S. INQUILINA, Wallr.; Fr. El. ii. p. 100. Named from specimens taken from my own herbarium. This species ought perhaps to be with the Caulicolæ rather than the Obtectæ. Fries (Adnotata) remarks, "*Sph. inquilina* Fr., nec Wallr., qui hanc innominatam misit. Equidem semper sincere citavi primos specierum determinatores."

315. S. ACUS, Blox. MS.!

316. S. PHOMATOSPORA, Berk. & Br.! Ann. & Mag. Nat. Hist. ser. 2. vol. ix. p. 380, pl. xi. fig. 33.

317. S. ARGUS, Berk. & Br.! Ann. & Mag. Nat. Hist. ser. 2. vol. ix. p. 322, pl. x. fig. 9.

318. S. APICULATA, Curr!

319. S. APPENDICULOSA, Berk. & Br.! Ann. & Mag. Nat. Hist., ser. 2. vol. vii. p. 189.

320. S. SIPARIA, Berk. & Br.! Ann. & Mag. Nat. Hist. ser. 2. vol. ix. p. 321, pl. ix. fig. 8.

321. S. (MASSARIA) AMBLYOSPORA, Berk. & Br.! *l. c.* p. 322, pl. x. fig. 10.

322. S. GIGASPORA, Desm.!

323. S. INQUINANS, Tode; Fr. S. M. ii. p. 486. Figured from specimens in my herbarium collected near Blackheath in March 1856. There is much confusion about *S. inquinans*, Tode. The only specimen in the Kew herbarium is from the Scleromycetes Sueciæ, no. 394, and is certainly the same thing as *S. amblyospora*, B. & Br. Tulasne (in the S. F. Carp. vol. ii. p. 236, under *Massaria Bulliardi*) makes *S. inquinans*, Tode, identical with *S. gigaspora*, Desm.; but at p. 134 of the same volume he identifies it with a plant described by me in the 'Microscopical Journal' (vol. iv. 1856, p. 198), which is certainly not *S. gigaspora*.

324. S. BUFONIA, Berk. & Br.!

325. S. FUSCELLA, Berk. & Br.!

326. S. TILIÆ, Pers. Syn. p. 84; Fr. S. M. ii. p. 485. Tulasne (S. F. Carp. vol. ii. p. 231) makes a new species of this, under the name of *Massaria Curreii*, and says that my figs. 105 & 106 are the true *S. Tiliæ*, Pers. All the specimens of *S. Tiliæ* at Kew (named by Purton, Fries, and Mougeot) are without fruit. Fries remarks (Adnotata), "Structura a me observata plane recedit. Videtur duplex, jam a Persoonio distincta, sub hoc nomine vagare."

327. S. ASHWELLIANA, Curr.!

DIV. 24. OBTURATÆ.

328. S. MILLEPUNCTATA, Grev.!

329. S. FRAXINI, Fr. Named by Klotzsch. Fries (Adnotata) remarks, "Mea species per corticem erumpenti-libera cum *Sph. corticola* jungi nequit. Fingo hanc statum primarium stylosporum *Tympan. Fraxini*."

330. S. CORTICIS, Sow. t. 372. f. 5; Fr. S. M. ii. 481, El. ii. 98. From the Scleromycetes Sueciæ, no. 391. The septate sporidia here referred to occurred in a specimen in my herbarium collected at Eltham in October 1856.

331. S. TRANSVERSALIS, Schw! Fr. El. ii. 94.

332. S. JUGLANDIS, Fr. S. M. ii. 493. Named by Berkeley; but I could only find stylospores on reexamination. Fries (Adnotata) remarks upon this and no. 333, "Hæ duæ formæ promiscuæ nascuntur et pro diversis ejusdem speciei formis habentur."

333. S. JUGLANDIS, Fr.! S. M. ii. 493. See remarks under no. 332.

334. S. INSPERSA, Schwein.!

335. S. (SPHÆROPSIS) UBERIFORMIS, Fr.! S. M. ii. p. 491. Fries remarks (Adnotata), "*Sph. uberiformis* = *Topospora uberiformis* Summ. Veg. Sc."

336. S. (HENDERSONIA) OPPILATA, Fr.! S. M. ii. p. 493. Fries (Adnotata) remarks, "In statu typico ascigera!"

337. S. (HENDERSONIA) PALINA, Fr. S. M. ii. p. 494. Named by Mougeot.

338. S. (HENDERSONIA) STROBILINA, Holl. and Schm. There are several specimens in the Hookerian herbarium, but none authentic. The figure here given agrees with an authentic specimen in my own herbarium. There are no asci.

339. S. LONICERÆ, Fr. S. M. ii. p. 492. Named by Mougeot. A specimen from the Scleromycetes Sueciæ (no. 349) has no fruit.

340. S. PISIFORMIS. Sent by Persoon in a letter to Mougeot. Fries (Adnotata) remarks, *Sph. pisiformis P.* = *Cytispora pisiformis* Duby Syn. Gall., S. V. Sc."

341. S. (SPHÆROPSIS) OBTURATA (not "obtusata," as in text), Fr.! S. M. ii. p. 495. From the Scleromycetes Sueciæ, no. 128.

342. S. (HENDERSONIA) SYRINGÆ, Fr.! S. M. ii. p. 492. From the Scleromycetes Sueciæ, no. 233.

Div. 25. SUBTECTÆ.

343. S. (DIPLODIA) ILICIS, Fr. S. M. ii. p. 501. Named by Berkeley. I could find no fruit on reexamination.

344. S. (DIPLODIA) SARMENTORUM, Fr. ! S. M. ii. p. 498. From the Scleromycetes Sueciæ, no. 18.

345. S. (SPHÆROPSIS) ATROVIRENS β. *Buxi*, Fr. Named by Klotzsch.

346. S. EPIDERMIDIS, Fr. S. M. ii. p. 499. Named by Berkeley.

347. S. RUSCI, Wallr. Named from specimens in my own herbarium.

348. S. SERIATA, Curr. !

Div. 26. CAULICOLÆ.

349. S. DOLIOLUM, Pers. ; Fr. S. M. ii. p. 509. In an authentic specimen of Persoon's the sporidia are 3-septate, *slightly* constricted at the septa, varying from 0·0008 to 0·001 inch in length. Fig. 122 is hardly correct. The two right-hand sporidia of fig. 137 are exactly like those of Persoon's plant. Perhaps *S. Helenæ* is a form of *S. doliolum.* The second joint of the sporidia in the latter is sometimes swollen.

350. S. DEMATIUM, Pers. Fr. S. M. ii. p. 505. Described from a specimen from the Scleromycetes Sueciæ. Persoon's specimens are quite imperfect.

351. S. ARUNDINIS, Fr. S. M. ii. p. 510. Named by Mougeot.

352. S. (SPHÆROPSIS ?) CORNI SUECICÆ, Fr. ! From the Scleromycetes Sueciæ, no. 409.

353. S. (SPHÆROPSIS ?) ACUTA, Hoffm. From the Scleromycetes Sueciæ, no. 118.

354. S. COMPLANATA, Tode. There are numerous specimens. None authentic.

355. S. CONIFORMIS, Fr. S. M. ii. p. 508. Named by Berkeley.

356. S. IMBERBIS, Fries ! Scleromycetes Sueciæ, no. 403. Fries remarks (Adnotata), "Fons Scler. Suec. Exs. 403 bis. Forma tertia Auctoris est *Cryptosporium imberbe*, S. V. Sc. p. 423 ; perithecium enim spurium ab epidermide nigrifacta ortum."

357. S. PHÆOSTICTA, Berk. !

358. S. (HENDERSONIA) ZEÆ, Schwein. ; Fr. S. M. ii. p. 527. The first plant here described is named by Mr. Berkeley, but is quite different from the other, which I now find to have been named by Schweinitz himself. On reexamination of the latter, I have found asci and sporidia, besides the fruit of *Hendersonia arcus*, Berk. & Br. ; and I am quite convinced that *S. Zeæ*, Schwein., is nothing more than *Sph. pulicaris*, Fr., and that *Hendersonia arcus*, Berk. & Br., is a stylosporous state of the latter Sphæria.

359. S. PELLITA, Fr. S. M. ii. p. 503. Named by Klotzsch. The perithecia are hairy, and the sporidia sometimes exceed 0·0016 inch.

360. S. NIGRELLA, Fr. ! S. M. ii. p. 512. Named by Berkeley.

361. S. PISI, Sow. Named by Berkeley.

362. S. ASTRAGALI, Curr.! Fries remarks (Adnotata), "*Sph. Astragali* ob locum conferatur cum *S. melæna*, S. V. Sc."

363. S. ACUMINATA, Sow.; Fr. S. M. ii. p. 506. Named by Berkeley.

364. S. CARICINA, Desm.!

365. S. (DIPLODIA) CALVESCENS, Fr.! From the Scleromycetes Sueciæ, no. 401.

366. S. CLIVENSIS, Berk. & Br.! Ann. and Mag. Nat. Hist. ser. 2. vol. ix. p. 379, pl. xi. fig. 29.

367. S. RUBELLA, Pers.; Fr. S. M. ii. p. 506. From the Scleromycetes Sueciæ. I suspect the length of the asci is more variable than the measurement here given would imply.

368. S. HELENÆ, Curr.!

369. S. HERBARUM, Pers.; Fr. S. M. ii. p. 511. The specimens of this are (as might be expected) very numerous. Persoon's specimen has no fruit; but the species is too common to admit of any doubt. There is a plant marked by Persoon *S. herbarum β. tecta*, which is something quite different. It has long, linear, multiseptate sporidia, as long as, and quite filling, the ascus. I never saw the species before. It is quite different from *S. acuminata*, Sow.

Div. 27. FOLIICOLÆ.

370. S. RHIZOMORPHÆ, Kunze. Named by Klotzsch.

371. S. TUBÆFORMIS, Tode; Fr. S. M. ii. p. 516. From the Scleromycetes Sueciæ, no. 26.

372. S. (SPHÆROPSIS?) MACULÆFORMIS, Pers.; Fr. S. M. ii. p. 524. Named by Berkeley.

373. S. (SPHÆROPSIS?) OLEÆ, D. C.; Fr. S. M. ii. p. 489. Named by Dr. Montagne.

374. S. (SPHÆROPSIS?) LEPTIDEA, Fr.! S. M. ii. p. 522. From the Scleromycetes Sueciæ, no. 13.

375. S. (SPHÆROPSIS?) DUPLEX var. *Nardi*, Fr. S. M. ii. p. 520. There are specimens named by Mougeot and by Fries (Scleromycetes Sueciæ, no. 85), but I could find no fruit in either on reexamination.

376. S.? PUNCTIFORMIS, Pers. From the Scleromycetes Sueciæ.

377. S. (SPHÆROPSIS) HEDERÆ, Sow.; Fr. S. M. ii. p. 521. Named by Klotzsch.

378. S. (SPHÆROPSIS) ÆGOPODII, Pers.; Fr. S. M. ii. p. 526. For the description here given I wish to substitute the following, taken from an authentic specimen named by Persoon:—Apparently no perithecia; stylospores long, narrow, and fusiform, having normally a septum, or division of the endochrome, in the middle, but which is not always visible. Length of stylospores 0·004 inch. Pseudoperithecium formed of the tissue of the leaf.

379. S. (DISCOSIA) ARTOCREAS, Tode; Fr. S. M. ii. p. 523. From the Scleromycetes Sueciæ, no. 151. Fries (Adnotata) remarks, "Quam maximi momenti observatio, *Dis-*

cosias in statu typico esse ascigeras! Sic successive omnia Pyrenomycetum genera absque ascis ad ascigeros migrant vel, ut *Sphæropsides*, status spermogoniis instructi censendi."

Although I have seen asci in *Discosia alnea*, Fr., I have not yet observed them in *D. Artocreas*, Fr. In my former paper I conjectured that the sporidia of the latter species were formed in asci, which deliquesce at an early stage. This is by no means improbable, although the sporidia of *D. Artocreas* are certainly sometimes borne singly upon sterigmata. In the perfect state of *Sphæria pulicaris*, Fr., the sporidia are produced in asci, whilst in the so-called *Hendersonia arcus*, B. & Br., which I believe to be only the stylosporous condition of *S. pulicaris*, similar sporidia are borne upon sterigmata. In the stylosporous condition of *D. Artocreas*, the second filiform appendage is not visible whilst the stylospores are attached to the hymenium, although the setum at the distal end is perfect.

380. S. (DISCOSIA) ALNEA, Fr.! S. M. ii. p. 520. From the Scleromycetes Sueciæ no. 50. See remarks under no. 379.

381. S. GLAUCO-PUNCTATA, Grev.! Fl. Edin. Fries (Adnotata) remarks, "*Sph. glauco-punctata* a *S. Rusci* (No. 347) haud differt." Cfr. Elench. ii. p. 103.

382. S. (SPHÆROPSIS) PALUSTRIS, Fr.! in lit. to Mougeot.

383. S. SPHÆROPSIS) VINCÆ, Fr.! in lit. to Mougeot.

384. S. SETACEA, Pers.; Fr. S. M. ii. p. 518. Named (I think) by Klotzsch.

DIV. 28. DEPAZEA.

385. S. (HENDERSONIA) CORNICOLA, Dec.; Fr. S. M. ii. p. 530. Named by Berkeley.

386. S. (DEPAZEA) VAGANS, Fr. S. M. ii. p. 532. Named by Berkeley.

387. S. (DEPAZEA) UVARIÆ, Berk.!

388. S. (DEPAZEA) FRAXINICOLA, MS. Named by Klotzsch.

389. S. DRYMIDIS, Berk.!

390. S. (DEPAZEA) PALLOR, Berk! Ann. Nat. Hist. ser. 1. vol. vi. p. 362, pl. ii. fig. 2.

391. S. (DEPAZEA) GRAMINICOLA, Berk.! Ann. Nat. Hist. ser. 1. vol. i. p. 207.

392. S. (DEPAZEA) BRASSICÆ, Pers.! in lit. to Mougeot.

393. S. (DEPAZEA) DIANTHI, Fr. S. M. ii. p. 531. Named by Berkeley.

394. S. (DEPAZEA) PISICOLA, Berk.!

395. S. (DEPAZEA) RIBICOLA, Fr. S. M. ii. p. 530. Named by Berkeley.

396. S. (DEPAZEA) FUSCELLA, Berk.!

397. S. (DEPAZEA) ALISMATIS, Curr.!

I must not omit to add the concluding remarks with which Fries closes the "Adnotata" which have been noticed above. He says, "Alias structuræ differentias a nobis observatas v. c. *Sph. moriformis* hac vice transeo. Haud paucas vir laudatus observavit

ascigeras, quas equidem legi stylosporas, alias equidem ascigeras, ille vidit stylosporas. Multiplex nuclei varietas est causa cur noluerim genera admittere nisi aliis differentiis et habitu proprio confirmata. Quam plurimas vidi Sphærias sporis primo simplicibus, dein uniseptatis, demum triseptatis; limites inter sporas septatas Curr. et pseudoseptatas et endochromate multipartito difficiles. Equidem sporarum colorem accuratius censeo indicare affinitatem.

"Ut *Discosiæ, Chætomia,* &c., sic etiam *Phoma,* genus eximie naturale, inter ascigeros citanda. Recentiores *Phomatis* nomen ad *Zythias,* a me jam pridem dictas, perperam retulerunt, licet character nullo modo in has quadret. Ejusmodi nominum transpositiones confusionem necesse pariunt, quare caute evitandæ et corrigendæ."

With reference to the above remarks upon the structure of spores, I may observe that I make no distinction between what I have called *pseudoseptate* spores and spores with multipartite endochrome. I apply the term "pseudoseptate" to those spores in which the separate portions of the endochrome are in such close contact as to give rise to the appearance of septa where none really exist. It is quite likely that in all such spores true septa are eventually formed. The question as to the value of the *colour* of the spores is too extensive to be discussed at the end of this paper. In some genera (e. g. *Cordyceps, Xylaria, Hypoxylon*) the colour is very constant; in others, again (e. g. *Diatrype, Valsa*), there is much variety. Even closely allied species (e. g. *Valsa quaternata, V. turgida*) sometimes differ considerably in the colour of their sporidia.

VIII. *On the Asymmetry of the* Pleuronectidæ, *as elucidated by an Examination of the Skeleton in the* Turbot, Halibut, *and* Plaice.

By RAMSAY H. TRAQUAIR, *M.D., Demonstrator of Anatomy in the University of Edinburgh. Communicated by* Professor HUXLEY, *F.R.S. & L.S.*

(Plates XXIX.–XXXII.)

Read June 15th, 1865.

Introduction.

THAT both eyes of a Turbot, or of the Pleuronectidæ generally, are situated on one side of the head is a fact long interesting to naturalists in connexion with the peculiar habits of these animals. It also affords an interesting field for the anatomist and embryologist to ascertain what relation this asymmetry bears to the morphological plan of the fish-head in general.

And indeed, if we merely look at the exterior of such a fish as the Turbot, the manner in which the transposition of the eyes has been effected is not very apparent. It is, it is true, easy enough to imagine that the mesial line of the top of the head has been simply twisted over to one side, carrying with it the eye of the opposite. But the dorsal fin, which stretches all along the back in what is assuredly the mesial line of the fish, extends also uninterruptedly in the same straight line on to the head, beyond the eyes, and between the nostrils to nearly the end of the snout. If the mesial line of the top of the head has been twisted, why has such a distinctly median structure as the dorsal fin not undergone the same process at its cephalic extremity?

Or we may imagine that, in early development, one of the eyes has passed bodily through the head till it has reached that side where both are now found, and where it has formed for itself a new and anomalous orbit—a view which, it must be confessed, grates a little against most of our preconceived morphological ideas.

But from what we see on the outside of the fish we can only rashly speculate. It is only by means of anatomical and embryological research that we can gain an insight into the true state of the case.

Autenrieth is the oldest writer I have found who alludes to the subject anatomically, in a paper on the anatomy of the Plaice, published in the year 1800 *. His remarks on the osteology of the Plaice, however, are meagre; and his theoretical conclusions must appear to us now-a-days absurd, for he accounts in the following manner for the position of both eyes on the right side of the head. He says, "The examination of the skeleton shows us that the entire left side of the fore part of the cranium is, in reality, wanting, and that nature, in order not to lose an eye, was necessitated to put it into the hollow of the right cheek under the single remaining orbit."

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* Bemerkungen über den Bau der Scholle (*Pleuronectes platessa*) insbesondere, und den Bau der Fische, hauptsächlich ihres Skelets im Allgemeinen. Von Dr. J. H. F. Autenrieth. In Wiedemann's 'Archiv für Zoologie und Zootomie,' Theil i. 1800, S. 47 *et seq.*

Rosenthal (Ichthyotomische Tafeln, Berlin, 1812–1822), a little more rational in his ideas than Autenrieth, held the upper eye of the Flounder to be that of the left or now eyeless side, but accounted for its getting to the right side by supposing its being thrust through the head, and getting "placed between the long processes of the frontal bones after the manner of Cyclopean malformations." The view which occurred to him is then in accordance with the second theory suggested in the beginning of this paper, but which a careful examination of the osteology of a series of different species of flatfish will easily show to be untenable.

It is, however, to Meckel * that we owe most of our previous knowledge of the subject. He recognized correctly the homologies of the various cranial bones with those of the symmetrical fish, and was undoubtedly the first who saw clearly that, according to the first theory already mentioned, the two eyes of the flatfish are brought round to one side by a twisting process; but his notions as to the prolongation of the dorsal fin along the head are unsatisfactory, as we shall see afterwards†.

Van Beneden, in 1853, published a paper ‡, the first in which, so far as I know, notice has been taken of the development of the Pleuronectidæ. In this paper he has described a young Turbot taken probably soon after its extrusion from the egg, and in which that stage of development does not seem yet to have been reached when the eyes become both placed on one side. "In this young fish the mouth is perfectly symmetrical; the eyes are still on the two sides of the head, but the left is about to pass over to the right side; the nostrils are still symmetrical. The rays of the dorsal fin only yet descend to the middle of the cranium; *afterwards they stretch on in front of the eyes*; but it is necessary first that the twisting of the head should have taken place on the vertebral column." To these observations he adds the result of some made "on a Turbot of nearly adult size, in which the process of torsion is arrested when the eye has arrived at the middle line. The rays of the dorsal fin have not yet descended to more than in the embryo described; the two sides are equally coloured." In remarking upon this paper, I may say that here, for the first time, do we find distinctly announced the fact and doctrine that the dorsal fin is not primarily advanced so far forwards on the head as we find it in the fully developed flatfish, but that it advances after the eye has turned round, and then it proceeds straight forwards, regardless of the deviation of the original mesial line of the head. Thus we are afforded a ready and rational explanation of the difficulty which met us at first, namely as to how, if the middle line of the top of the head has been twisted over to one side, the dorsal fin, a mesial structure, has not followed that twisting. Van Beneden, however, is not the first to notice an occasional condition of the adult flatfish resembling that which he has described in his embryo[*]; but he seems to me to be the first to appreciate the morphological value of such phenomena.

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* Syst. der vergl. Anatomie, Theil ii.: Halle, 1824. Meckel's first observations on the subject appeared in a paper, "Ueber die seitliche Asymmetrie im thierischen Körper," in his 'Anatomisch-physiologische Untersuchungen,' Halle, 1822, a work which I have not had an opportunity of seeing.

† See p. 287, note.

‡ "Note sur la Symétrie des Poissons Pleuronectes dans le jeune âge," Ann. des Sciences Naturelles, 3e série, xx. pp. 340–342.

But very recently Steenstrup has revived the theory of Rosenthal, that the upper eye has passed through the head to the place it now occupies, and that this "migration" of one of the eyes has had a much more important share in bringing about the ocular transposition than any slight twisting that may have taken place[†]. According to his views, "The eye, at an early stage, must have quitted its primitive position, and, directing itself upwards and towards the interior, pierced the vault of the cranium constituted above the eye by the frontal bone, and formed for itself a new orbit, whether on the internal region of the frontal bone of the same side or between the two frontals." In support of this theory, he refers to the appearances presented by several very interesting young Pleuronectidæ, each about an inch long, brought from various localities in the Atlantic, and deposited in the Museum at Copenhagen, and directs especial attention to one in which one eye seems to be arrested in the process of piercing the head. In addition, M. Steenstrup remarks that the osteology of the head of the adult flatfish confirms his view of the process of ocular transposition in the embryo. Like Rosenthal, he compares the head of a flatfish to that of a Cyclopean malformation, and affirms that the position in which we find the upper eye is not homologous with that occupied by the lower, nor with the orbit of any other fish or vertebrate animal in general.

I can only say that the results of my own investigations do not agree with those statements of the above-quoted distinguished naturalist. What the views are which I have adopted will appear in the following paper; meanwhile I will only remark that the appearances presented by the cranium of the adult flatfish seem to me to be at complete variance with any theory that the two eyes of these animals occupy morphologically different positions from each other. In this communication I have named the bones according to the nomenclature given in Professor Owen's 'Lectures on Comparative Anatomy;' but, in doing so, I do not wish to be considered as committing myself to any of the general morphological ideas which may be associated with that nomenclature. Bones must, however, have names; and so long as our investigation does not trench on the general question of the homologies of the vertebrate skeleton, one system of names, provided it be widely known, may be used as advantageously as any other.

I. *On the Cranium of the Pleuronectidæ.*

In studying the cranium of the flatfishes, we must take into account the cartilage and membrane, which form morphologically as integral a part of the skeleton as the bones themselves. It will also be necessary to compare the cranium and its parts with that of a symmetrical fish; and, for this purpose, we may select the cranium of the common Cod (*Gadus morrhua*), a fish belonging to the same suborder (Anacanthina) of the Telostei as the Pleuronectidæ. As a standard for such comparison this cranium will do very well, the differences between its plan of structure and that of the flatfish-skull being really immaterial.

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[*] Cases of similar monstrosities or arrestments of development had been previously recorded, by Donovan as "Pleuronectes Cyclops," by Schleep as "Rhombus maximus duplex," and by Yarrell.

[†] J. Japetus Sm. Steenstrup "Om Skjaevheden hos Flynderne, og navnlig om Vandringen af det övre Öie fra Blindsiden til Öiesiden tvers igjennend Hovedet." Kjöbenhavn, 1864. Saerskilt Aftryk af Oversigt over d. K. D. Vid. Selsk. Forhandl. i. Nov. 1863.

"Observations sur le Développement des Pleuronectes," par M. Steenstrup (Annales des Sciences Naturelles, Paris, Nov. 1864).

The former of these two papers, being written in the Danish language, I have not yet read.

In such a cranium (Plate XXIX. fig. 16) we find three principal parts, each connected with one great organ of special sense.

1. A posterior cavity (Z) containing the brain and organ of hearing, this cavity being, in the macerated skull, widely open in front, and showing a "foramen magnum" behind for the exit of the spinal cord. Into its composition enter the basilar, exoccipital, paroccipital, supraoccipital, petrous, mastoid, orbitosphenoid, alisphenoid, part of the basipresphenoid, and part of the mid or great frontal bones, also a considerable quantity of unossified cartilage.

2. A middle or interorbital part (Y), consisting of part of the frontal bone above, part of the basipresphenoid below, with a fibrous membrane (the "septum interorbitale") extending vertically between them. This septum is formed by the coalescence of two fibrous laminæ, which close to a considerable extent the anterior opening of the brain-case, and also complete a groove on the under surface of the frontal bone into a canal which continues the brain-cavity as far forwards as the nose, and lodges the crura of the olfactory bulbs. Note, that while the basipresphenoid below remains a narrow bar, the frontal bone above forms a large broad arched plate, which both contributes to the general stability of the cranium and forms very efficient roofs for the orbits.

3. An anterior or nasal part (X), which contains no cavity, but presents two openings for the olfactory nerves—one on each side of a central mass of cartilage. This part of the cranium consists of four bones—the vomer below, the nasal bone above, and the two prefrontals on each side, each of which is notched internally for an olfactory nerve. All these bones are supported by the central mass of cartilage already referred to.

Another well-known circumstance in the structure of the skull of the Cod, as of other fishes, must be noticed, viz. that, when the individual bones are disarticulated, certain of them can be removed without in the least interfering with the primordial cartilage, of which a considerable quantity still remains. In the Cod these superficial bones, or "Deckknochen," are invariably the vomer, the basipresphenoid, the frontal, the parietals, and the petrosals. The other bones are so intimately connected to the cartilage, that they cannot be separated without tearing it and carrying away pieces of it in their substance. They are the basioccipital, paroccipitals, exoccipitals, supraoccipital, mastoids, postfrontals, alisphenoids, orbitosphenoids, prefrontals, and nasal.

The only differences worthy of note between the general plan of the Cod's skull as given above and that in the flatfishes are, that the two halves of the single frontal bone in the Cod are represented in the latter by two distinct bones, and that in the flatfishes the membranous interorbital septum contains no tubular prolongation of the brain-cavity. In the Pleuronectidæ and in the Gadidæ the relations of the bones to the cartilage are identical.

One of the simplest crania to be met with among the Pleuronectidæ is that of the Turbot (*Rhombus maximus*), of which illustrations are given in Plate XXIX. figs. 1-7). This cranium, truncated behind and somewhat pointed in front, presents superiorly a longitudinal ridge (fig. 1, β) which, though commencing posteriorly in the middle line, does not divide the head into two equal parts as it advances. On the contrary, the anterior part of the cranium is broader to the left than to the right of this ridge, or of its supposed continuation forwards in a straight line; and this happens both because the skull anteriorly is actually considerably broader on the left than on the right side, and because the ridge itself deviates a little, though very slightly, towards the right side. This ridge supports the cephalic continuation of the dorsal fin. Posteriorly we at once recognize the brain-cavity, with its foramen magnum for the exit of the spinal cord, and various other foramina for cranial nerves. In front of the brain-cavity, and to the left side, is an oval orbit (B), which lodges the upper eye, the lower eye lying free beneath the lower bony margin of that orbit. In front of the orbit we recognize the nasal part of the cranium, with its two olfactory foramina, one on each side of the central cartilage (A).

On comparing this cranium with that of the Cod, we observe that while in the latter the anterior and posterior parts of the skull are connected by two bars of bone—an inferior narrow one (basipresphenoid) and a superior flattened arch-shaped one (frontal)—we have here three bars, the two upper bounding between them the orbit for the upper eye. To the left of these two bars, which forms the lower boundary of the orbit and lies between the two eyes, I shall give the name *interocular*; and to the other one, which bounds the orbit on the right side, and proceeds forward in the apparent middle line, I give the name *pseudo-mesial*.

In the Turbot and its congeners the eyes lie both on the left side usually—the upper one in the orbit, the lower free beneath the lower margin of that orbit, formed by the interocular bar. As, however, in some other groups of flatfishes the eyes are usually on the right side, to prevent confusion I shall, in the description of the bones of the flatfish-head, abandon the terms "right" and "left" altogether, and use instead the terms "eyed" and "eyeless."

Proceeding now to disarticulate the Turbot's cranium, we find that posteriorly the bones are very little altered in their symmetry.

Basioccipital (1). The long axis of this bone is somewhat obliquely placed as regards the transverse plane of the disk on its posterior surface for articulating with the first vertebra, pointing a little towards the eyed side.

Exoccipitals (2). Very symmetrical.

Paroccipitals (4). The posterior projecting process is often longer on the eyeless side.

Alisphenoids (6). Very symmetrical.

Mastoids (8). Very nearly equal in size and conformation. That of the eyeless side, however, is generally a little longer than that of the eyed.

Petrosals (16). These bones are much smaller than in the Cod, and lie quite superficially. That of the eyeless side is in the Turbot always larger than the opposite one, and accordingly on the outside of the skull covers up more of the mastoid and exoccipital bones from view.

The *Postfrontal* (12) is longer on the eyeless side, and its long axis curves a little round to the eyed side. (See fig. 3, Plate XXIX.)

Parietals (7). As in the case of the postfrontals, the parietal of the eyeless side is considerably longer than its fellow. The difference is best seen when the bones are disarticulated.

The bones enumerated in the last paragraph show but little in regard to the symmetry of the head. In those next to be noticed, the indications are more decided.

Basi-presphenoid (5). This bone is slightly bent towards the eyeless side, a little behind its middle. For description it may be divided into three parts. The posterior flattened part, which overlaps the basioccipital, is symmetrical. The middle part presents above on each side an ascending laminar process or wing, which bounds laterally a channel lodging the origin of the eye-muscles, this channel, however, passing obliquely across the long axis of the bone from the eyeless towards the eyed side. The anterior part, which receives the pointed end of the vomer, is apparently twisted on its long axis up towards the eyeless side, this appearance being principally caused by a greater development in a more vertical direction of that side of the bone.

Orbitosphenoid (10). On the eyeless side this bone is longer than on the eyed side; the direction of its axis also agrees with that of the eye-muscle canal of the basi-presphenoid in pointing obliquely across to the eyed side (see Plate XXIX. fig. 3), the part shaded with horizontal lines indicating the cartilaginous tips of the bones.

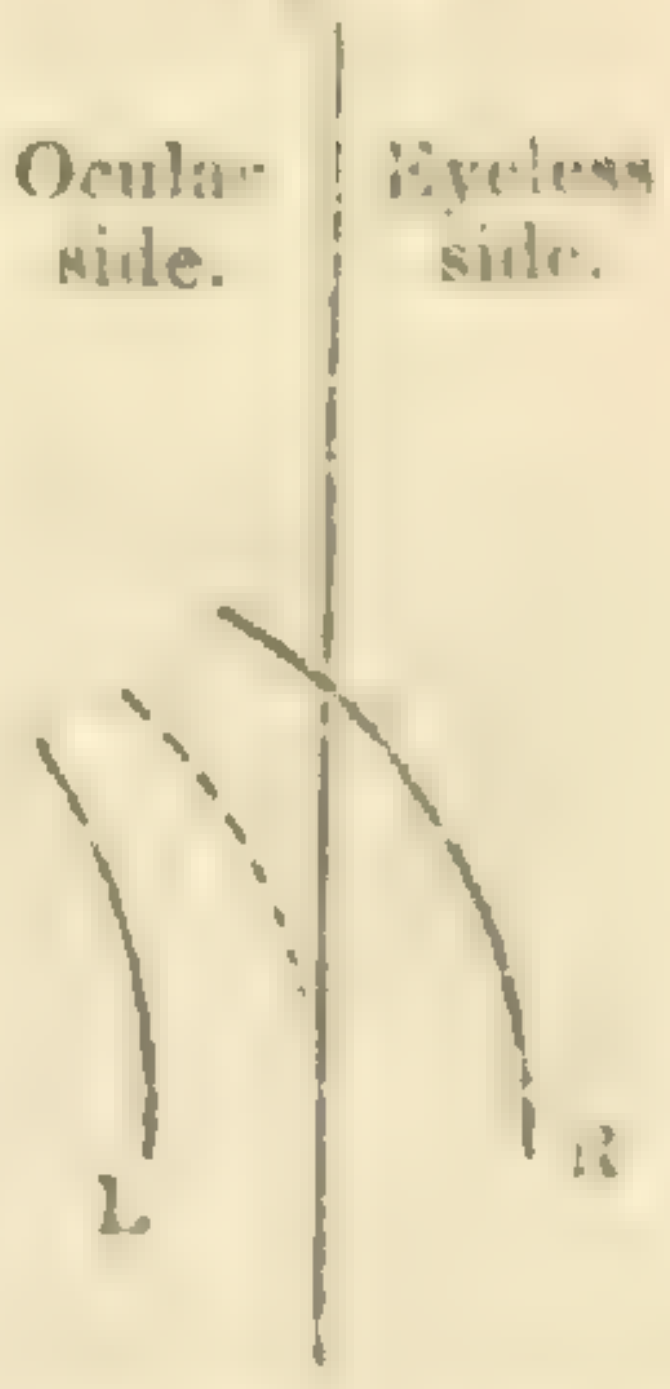
The Supraoccipital (3) presents a scale-shaped "body," forming part of the roof of the cranial cavity, surmounted by a very prominent ridge or spine. The flattened part is tolerably symmetrical; its long axis, often slightly curved, points, however, to the eyed side; but the spine (β), though commencing posteriorly in the middle line, passes forwards, with a slight deviation towards the eyeless side, impinges on the frontal bone of that side, and, if continued further forwards, would pass quite by the eyeless side of the orbit. Its direction, though thus slightly deviating, is, however, nearly in the midde line of the top of the head.

The supraoccipital bone is thus very unequally divided, the larger moiety being on the ocular side.

If now, before we proceed further, we turn to Plate XXIX. figs. 2 and 3, we shall see that, although the basal keel of the cranium is continued forwards in nearly a straight line, the long axis of the cranial cavity, which that keel underlies, points round to the eyed side, anteriorly crossing that keel at an angle. This is well illustrated by the structure of the basi-presphenoid bone itself (5) where the eye-muscle channel, which is simply the lower part of the cranial cavity, crosses the long axis of the bone. This also explains the reason why several of the cranial bones, as the parietal, mastoid, postfrontal, and orbitosphenoid, are longer on the eyeless side, simply because they have a longer extent to traverse, as is illustrated in the accompanying diagram (fig. 1.)

Notice also that, although the long axis of the supraoccipital bone follows the general twist of the cranial cavity in pointing towards the eyed side (indicated by the dotted line in the diagram), the spine of the bone continues forwards nearly in the same straight line as the middle line of the entire fish (indicated by the straight line in the diagram). To the first of these lines, continuing forwards the axis of the body of the supraoccipital bone, I give the name "morphological middle line;" and to the line of the spine of the supraoccipital, which also supports the cephalic prolongation of the dorsal fin, the name "pseudomesial."

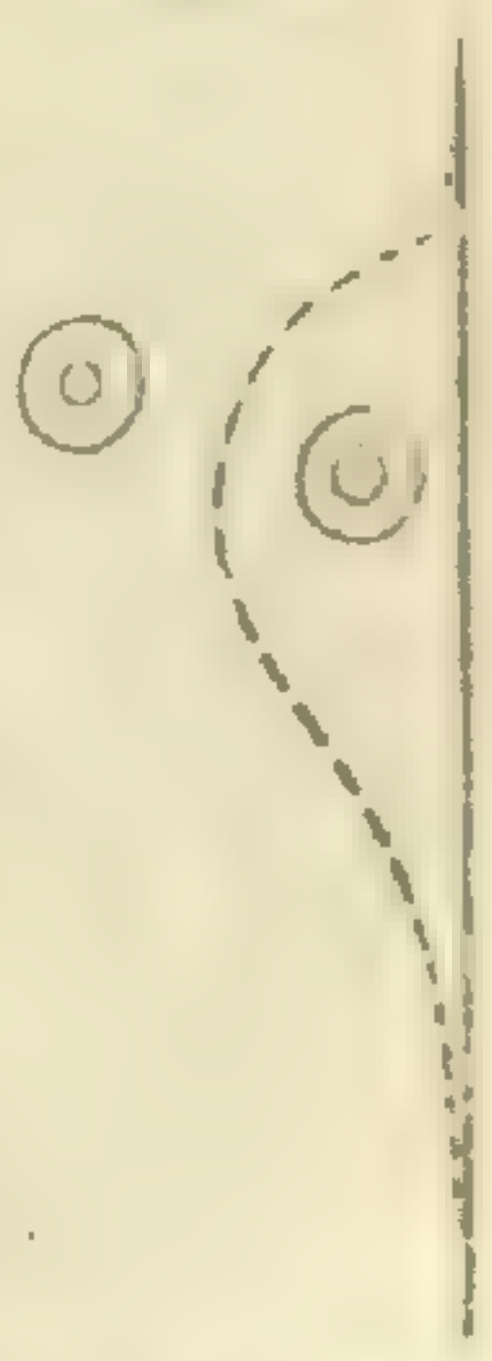
Fig. 1.



In advance of the orbitosphenoid, postfrontal, parietal, and supraoccipital bones are two bones (11′ & 11), which, from their position, must be the frontals. Each consists of a posterior somewhat square-shaped part, forming part of the roof of the brain-cavity, and of an anterior more slender curved part, which, with its fellow of the opposite side, forms the interocular bony ridge or bar. The anterior part of the bone of the ocular side (*m*′, Plate XXIX. figs. 1 & 7) is strongly curved, the concavity looking upwards and to the eyeless side; at its extremity it articulates with the prefrontal of its own side, touches the nasal bone, and rests likewise on a portion of primordial cartilage, to be presently described (A, fig. 1). The bone of the eyeless side (Plate XXIX., fig. 7, 11) is distinguished by having its posterior part larger, the external anterior angle (*n*) projecting forwards so as to take a slight part in the formation of the pseudomesial bar of the cranium, which bounds the orbit on the eyeless side. The anterior part (*m*) ("interocular process") is much more slender than the corresponding part of the bone of the ocular side, and to which it is closely applied; at its extremity it likewise rests on a portion of primordial cartilage, but does not touch its corresponding prefrontal. It forms the entire lower boundary of the orbit, and, with its fellow of the opposite side, forms the interocular bar of the cranium.

We now see that the morphological mesial line continued from the supraoccipital bone in the line separating the two frontal bones from each other, at first deviating but slightly towards the eyed side, afterwards curves round the orbit along the interocular bar till anteriorly it tends again to coincide with the apparent middle line, as in the adjoining diagram. In the figures of crania (Plate XXIX.) I have also represented the course of the morphological middle line by a dotted line. That this is the true morphological middle line, and that the interocular bar is the only and complete homologue of the frontal arch in the Cod, is proved simply by the fact that between the interocular bar and the basi-presphenoid bone there extends a fibrous membrane, having imbedded in it the olfactory nerves as they proceed to the nasal fossæ in front. This membrane represents the fibrous interorbital septum in the Cod; but, by the twisting over of the mesial plane of the ocular region to one side, this septum in the Turbot, instead of remaining vertical, has become nearly horizontal, and instead of coinciding with the mesial plane of the rest of the fish, has become set nearly at right angles to it. In the Turbot, as in all the other Pleuronectidæ, the olfactory nerves are not contained in a tubular prolongation of the brain-cavity at the top of the interorbital septum as in the Cod, but are simply imbedded in its substance. The ophthalmic branches of the fifth nerve on each side, which in the Cod lie beneath the frontal arch, here curve round between the eyes, along

Fig. 2.



the interocular processes of the frontal bones, till they end in the nostrils and front of the snout.

The main slime-canals, one for either side, which in the Cod pass between the eyes over the frontal arch, here pass between the eyes along the interocular bar, being channelled out in the interocular process of its corresponding frontal bone. (See Part III. of this essay.)

But what, then, is the pseudomesial bar or bridge in the Turbot's cranium, if the interocular bar be the complete representative of the frontal arch in the Cod? This we shall see presently.

We now come to the anterior or nasal part of the cranium, characterized by two olfactory foramina, of which that of the ocular side is more anterior than the other. As in the Cod, this portion of the cranium consists of a central piece of cartilage, supporting four bones, the vomer below, the nasal above, and the two prefrontals, one on each side.

The Cartilage.—This portion of cartilage (A, figs. 1–5), more extensive than the corresponding remnant in the Cod, appears as a very rudely quadrangular plate with a large hole through its middle, connected to bones all round its edges, save the concave posterior one, which is continuous with the fibrous septum between the eyes, already referred to. On each side of it an olfactory nerve passes to its corresponding olfactory foramen in the direction indicated by the bristles in Plate XXIX. figs. 3–5. It therefore indicates the morphological mesial plane of the anterior part of the cranium, and would be vertical were it not for the twisting over to one side which has occurred. It rests beneath on the basi-presphenoid and vomer; in front it supports the nasal bone (15), and laterally, round its anterior inferior angle, it is intimately connected to the prefrontals (14′ & 14), one on each side. Above, the anterior extremities of the interocular processes of the frontal bones rest on it, as follows:—A longitudinal notch divides the upper edge of the cartilage into two unequal pointed processes (*g* & *h*, Plate XXIX. figs. 3–5). Of these, that of the eyed side (*g*), by far the largest, is lodged in a hollow on the under surface of the stout interocular process of the frontal of the same side, and supports also the posteriorly directed process (*a*) of the corresponding prefrontal (14); the other one (*h*) is similarly related to the end of the slender interocular process of the frontal of the eyeless side, but is not touched by its prefrontal, save at its very base. Now this notch, separating those two processes, as it indicates the line of separation between the interocular processes of the two frontal bones, must likewise indicate the morphological middle line of the cartilage; so that here we have a mesial cartilage, not only unsymmetrical in its position, but also in the development of its two sides, the greater development being on the ocular side of the fish.

Vomer (13). The posterior part of the vomer, which fits into a groove on the lower aspect of the basi-presphenoid, is more developed on the eyeless than on the eyed side; on the eyeless side also the ala for articulating with the prefrontal is larger, and projects more vertically upwards than on the opposite side; so that, like the anterior part of the basi-presphenoid (p. 268), the vomer has slightly the appearance of being twisted up on its long axis towards the eyeless side. In outward form, however, the head of the bone which bears the vomerine teeth (Plate XXIX. fig. 2) does not participate much in this apparent twisting.

Nasal (15). This bone is tolerably symmetrical as regards the development of its two sides. In front it presents a deep transverse notch, at which point the bone is slightly bent, the concavity being towards the ocular side. We have then the nasal prominence divided into two parts by the aforesaid notch, the upper (*i*, figs. 5 & 6, Plate XXIX.) giving attachment to ligaments connected with the maxillary bones, and continuing forwards the direction of the still oblique morphological middle line; the lower and anterior (*k*) forming an articular ridge, on which the intermaxillary nodule of cartilage glides downwards and upwards, and forwards and backwards, as the jaws open and shut, coincides in its direction with the pseudomesial line also; so that the notch between these two prominences of the nasal bone is the point where the morphological middle line again returns to the apparent middle line of the top of the head (see Plate XXIX. fig. 1).

The two *prefrontals* are at once known by the notch borne by each, and which is completed into an olfactory foramen (c) by the contiguous nasal bone.

The *prefrontal of the eyed side* (14′) is somewhat triangular in shape; anteriorly and to the inner side it presents the notch already spoken of, articulates with the nasal bone, and touches the primordial cartilage. Below the olfactory notch it is extensively continuous with the primordial cartilage, and also sends down a process (*c*) which articulates with the corresponding ala of the vomer. Opposite the olfactory notch, and on the outer side of the bone, is a prominence (*e*) to which the anterior suborbital bone of that side is attached; and posteriorly a pointed process (*a*) is sent back, which articulates with the interocular process of the corresponding frontal bone, and rests internally on the primordial cartilage which forms the anterior part of the "septum iuterorbitale" (see p. 266).

The *prefrontal of the eyeless side* (14) is much larger, and of a rudely quadrangular shape. Anteriorly it is similarly related to the nasal bone, and presents the same olfactory notch that we saw in the other bone. The same process (*c*) is sent downwards and forwards to articulate with the vomer; and an additional one (*b*) is sent downwards and backwards to articulate with the basi-presphenoid. But the great mass of the bone projects backwards in a great flat quadrangular process (*f*), which, instead of articulating with the interocular process of the frontal of the eyeless side, as the posteriorly directed process (*a*) of the other prefrontal does with its corresponding frontal, passes round the other side of the orbit, and, joining the external angular process of the frontal of the eyeless side, forms, with it, the pseudomesial bar of the cranium, which bounds the orbit on the eyeless side.

The orbit which contains the upper eye, then, is bounded posteriorly and on the outer side by the interocular process of the frontal of the eyeless side, at the anterior angle by a small portion of primordial cartilage (*s*), on the inner side by the external angular process of the frontal of the eyeless side and by the posteriorly directed process (*f*) of the corresponding prefrontal.

If we now examine the prefrontal bones in the Cod, the lateral aspect of one of which is figured in Plate XXIX. fig. 16 (14), and disarticulated in fig. 17, we shall find that the connexions of each bone are as follows:—

1. It shows two processes (*d d*) going towards the nasal bone, with an olfactory notch between them (c).
2. An anteriorly directed process (*c*) for the ala of the vomer.
3. A posterior-inferior process (*b*) for articulation with the basi-presphenoid.
4. A posterior-superior process (*a*) going upwards and backwards to join the frontal bone.
5. A lateral process (*e*), tipped with cartilage, opposite the olfactory notch, to which the anterior suborbital bone is attached.

Now, on comparing the prefrontal of the ocular side in the Turbot with this, we find that everything corresponds exactly, save that the process (*b*) for articulation with the basi-presphenoid is wanting, the interval being filled up by mere cartilage. (Plate XXIX. figs. 2, 4, 5.)

The prefrontal of the eyeless side, though it presents a large process (*b*) for articulation with the basi-presphenoid, shows no trace of the process (*a*) for articulating with the interocular part of the frontal; it does not touch it at all. But what, then, is the large process *f*? That it is not homologous with the process (*a*) projecting upwards and backwards in the Cod and in the other prefrontal of the Turbot, is evident from its bearing no relation to the olfactory nerve of its side, nor to the interocular septum. On the other side, the olfactory nerve runs close beneath the process *a*, as indicated by the bristle in Plate XXIX. fig. 4. It follows, then, that this process (*f*) in the prefrontal bone of the eyeless side is an additional process having no homologue either in the Cod or in the prefrontal of the opposite side in the Turbot. We may call it "external angular," corresponding with that process already described in the frontal of the same side, and which has also no homologue in the Cod or in the eyed side of the Turbot.

And now we see what the nature of that bar of bone is, which I have called pseudomesial (p. 267), and which one is apt at first to think homologous with the whole or part of the frontal arch in the Cod and other symmetrical osseous fishes. Seeing that the true homologue of the frontal arch in the Cod's head has been reduced to a narrow bar, and twisted over to one side (p. 269), we have, in the pseudomesial bar, a secondary formation destined to supply the place of the weak and displaced frontal arch in forming a strong and efficient bridge of connexion between the anterior and posterior parts of the cranium, and also to support the cephalic continuation of the dorsal fin.

The cranium we have just considered is the least asymmetrical and most easily understood which I have met with in the Pleuronectidæ. We shall now proceed to examine and compare with it the crania of some of the other Pleuronectidæ, and note to what further steps the process of distortion proceeds, before finally generalizing on the changes which have taken place.

The cranium of the Brill (*Rhombus vulgaris*) is nearly identical with that of the Turbot. But we must remark that the interocular process of the frontal of the eyeless side is proportionally more slender than in the Turbot, while the external angular process of the same bone is more pronounced, and forms more of the inner wall of the orbit, than in the last-named fish.

In the group of flatfishes to which the Flounders belong, we find the rays of the dorsal fin advancing only so far as the middle of the orbit; and the eyes are normally placed on the right side of the head. There is also a very marked tendency for the mouth to become twisted towards the opposite side of the body to that on which the eyes are placed.

As characteristic of this group, we first consider the cranium of the Halibut (*Hippoglossus vulgaris*) (Plate XXIX. figs. 8–11).

On looking at the under surface of the Halibut's cranium (Plate XXIX. fig. 9), we find the basal keel pretty straight in itself; but when the head is *in situ* on the end of the vertebral column, this keel points strongly to the eyeless side. In the occipital region the skull is apparently broader on the eyed than on the eyeless side; this is due to a greater prominence on that side of the mastoid (8) and exoccipital (2) bones; the petrous (16) is also larger. The middle line of the posterior aspect of the skull is also strongly curved, the convexity being towards the ocular side, and corresponds with a similar curve, to be afterwards alluded to, in the spinous processes of the anterior vertebræ (p. 285).

The *basioccipital* (1) is unsymmetrical, the middle line of the inferior surface pointing to the eyeless side, while that of the upper surface of the bone, indicating the twist of the cranial cavity, diverges towards the eyed side. The mesial vertical plane of the bone is therefore pushed over to the eyed side anteriorly.

The *basi-presphenoid* (5) presents in a much more exaggerated form than in the Turbot the apparent twisting-up of its anterior part on its long axis towards the eyeless side; here, indeed, the groove in which the end of the vomer is inserted looks quite to that side. The axis of the entire bone points to the eyeless side, as I have already noticed.

The *postfrontal* of the eyed side (12) has the semilunar excavation, which, by a similar one in the alisphenoid bone, is completed into an articular cavity (D) for the head of the epitympanic, placed further forwards on its surface than on the eyeless side, so that the attachment of the suspensory apparatus to the cranium reaches further forwards on the former than on the latter side. This is important in connexion with the conformation of the bones of the face (p. 278).

The *orbitosphenoid* (10) is larger on the eyeless than on the eyed side, and its long axis points considerably over towards the eyed side. In the view of the under surface of the skull given (Plate XXIX. fig. 9) the real size of this bone is not apparent, owing to its concealment by the basi-presphenoid.

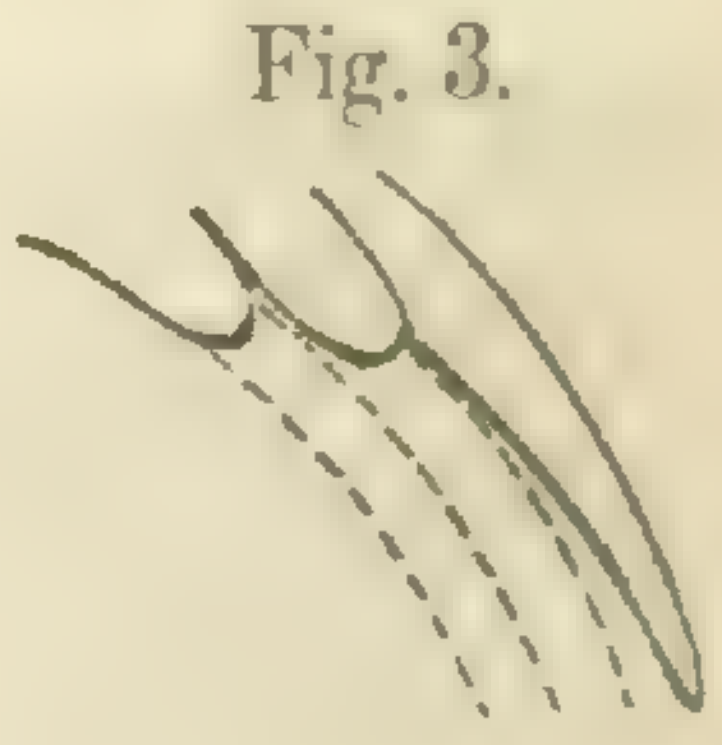
The *supraoccipital* (3) shows in a more marked manner than in the Turbot the divergence of the morphological from the apparent middle line at the back of the head. Its direction is indicated by the red line in the figure.

The *parietal* of the eyeless side (7) is broader than the opposite one, which latter, however, is often a little longer.

The *frontal* of the eyed side (11′) corresponds very much in shape with the same bone in the Turbot. But that of the eyeless side (11) has its external angular process much more developed, forming more than one-half of the inner wall of the orbit, while the interocular process is reduced to a mere curved spiculum (*m*, fig. 11), passing all round the outer margin of the orbit, closely applied to the stouter interocular process of the other frontal bone. A ridge continued from the supraoccipital bone passes over the frontal of the eyeless side, and on to its external angular process; it supports the cephalic continuation of the dorsal fin.

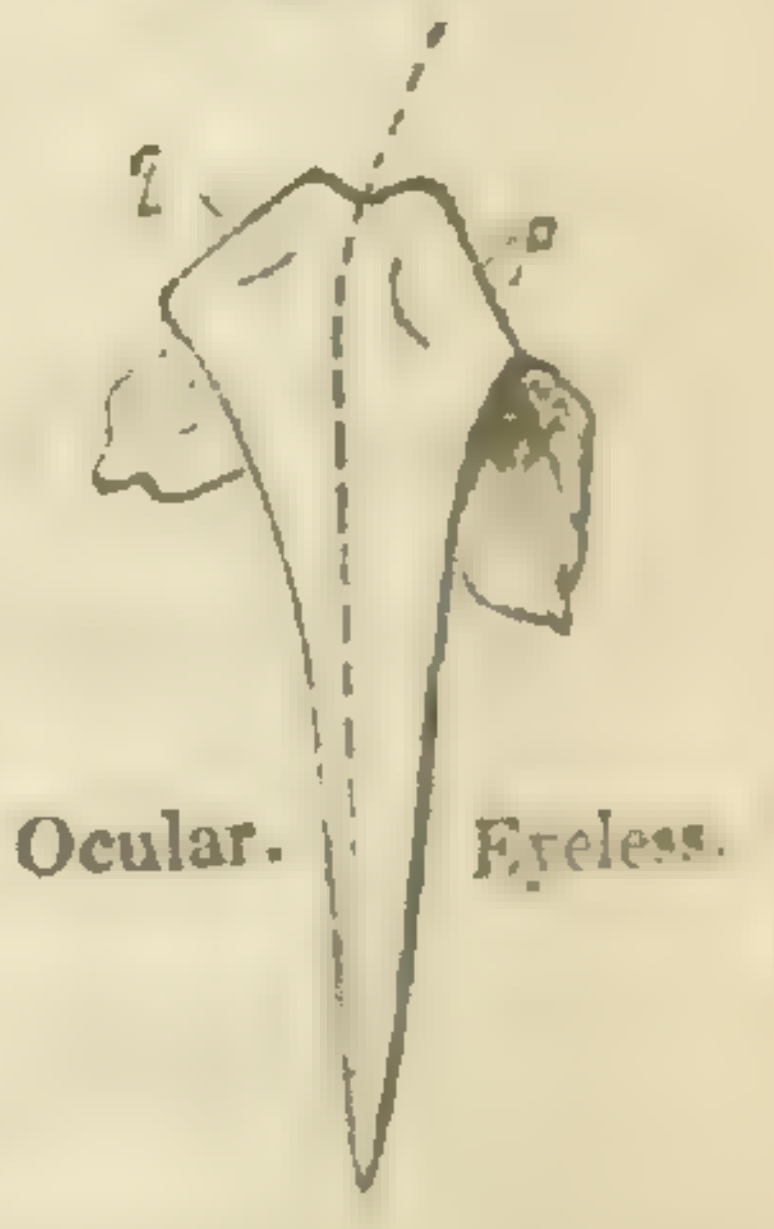
Anterior Part of the Head.—The Cartilage (Plate XXIX. figs. 8–10, A).—This is thinner and smaller than in the Turbot, but its shape and relations are analogous. Its upper border is divided by two notches into three very unequal processes, of which that on the ocular side, by far the largest, extends posteriorly, and supports the process (*a*) of the prefontal of the ocular side. Into the larger notch (*g*) on the ocular side is inserted the extremity of the interocular process of the frontal of the same side; and into the smaller notch (*h*) on the other side is inserted the extremity of the corresponding part of the frontal of the eyeless side, in the manner represented in Plate XXIX. fig. 8. This cartilage, then, as in the Turbot, is very unequally developed on its two sides, the side corresponding to the eyeless side of the fish appearing as if quite atrophied—corresponding with the small size of the interocular process of the frontal and the complete non-development of the process (*a*) of the prefrontal of the eyeless side (see p. 272).

Fig. 3.



Vomer (13).—This bone appears twisted on its long axis up towards the eyeless side, as in the Turbot, but in a more exaggerated degree (see Plate XXX. fig. 3, where the vomer is seen from the front). Anteriorly it presents two articular facets (*p* & *q*, figs. 8, 9, Plate XXIX.), of which that on the eyeless side (*p*) is larger, and looks more laterally than the opposite one (*q*); a line bisecting the angle formed by these two facets would pass obliquely towards the eyeless side, as in the adjoining diagram. The lateral ala on the eyeless side, besides being larger, and directed more vertically upwards, is also directed more posteriorly than the opposite one; so that the bone, in addition to being twisted on its long axis upwards and to the eyeless side, has that axis turned to the eyeless side at its extremity, as indicated by the dotted line in the diagram. The full import of this will be seen when we consider the bones of the face.

Fig. 4.



Nasal.—The prominence (*k*) on which the intermaxillary cartilage glides is obliquely directed towards the eyeless side. The nasal bone in the Halibut is more expanded transversely than in the Turbot, and thus comes to enter into the boundary of the orbit (Plate XXIX. figs. 8 & 10, 15). It is also apparent that this increase of size transversely is chiefly due to development on its eyeless side.

Prefrontals (14′ & 14).—These are more nearly of the same size as in the Turbot, though that of the eyeless side is still a good deal larger than its fellow. I have already alluded to the fact that in the Turbot the process (*a*) of the prefrontal of the ocular side, which articulates with the interocular process of the corresponding frontal, is not at all developed in the prefrontal of the eyeless side, an interval filled by cartilage (*s*, Plate XXIX. fig. 1) being left between the frontal and prefrontal anteriorly on that side. In the Halibut the prefrontal of the eyeless side, at the place where the process (*a*) should be given off, is still less developed, and, the primordial cartilage in this region being less extensive than in the Turbot, a space is left in the anterior wall of the orbit, which is filled up by a development from the corresponding side of the nasal bone. (Compare the boundaries of the orbit in Plate XXIX. fig. 1 and in fig. 8.)

In the cranium of *Platessa pola* the interocular process of the frontal of the eyeless side presents a form intermediate between its condition in the Halibut and that in the Plaice, next to be described. It is continued between the eyes as a very slender spiculum, much more delicate than the corresponding part in the Halibut, and very apt to be broken off in disarticulating the skull. The external angular process of the same bone is very largely developed, and, with the corresponding part of the prefrontal of the eyeless side, forms the pseudomesial bar of the cranium into an expanded and flattened vertical plate, apparently designed to support the curious series of ampullated mucous canals on the eyeless side of the head of this fish (see Plate XXXI. figs. 6, 7). The two frontal bones are represented in Plate XXIX. fig. 15.

In the Plaice (*Platessa vulgaris*) the general form of the cranium is much the same as in the Halibut; but some of the asymmetries indicated in the latter have run to a much greater excess.

The keel, on the under surface of the cranium (Plate XXIX. fig. 13), is strongly bent towards the eyeless side, and its anterior extremity is also twisted strongly upwards on its long axis towards the same side.

The external angular process of the frontal of the eyeless side (Plate XXIX. fig. 14 *n*) is similar to that in the Halibut; but the interocular process (*m*) is almost completely non-developed, so that the greater part of the lower or external boundary of the orbit is formed by the frontal of the ocular side; and this circumstance might easily lead a superficial observer to imagine that the interocular process of the bone of the ocular side is homologous with the external angular of the opposite one. This seems to have been Rosenthal's idea when he speaks of the upper eye being "placed between the two long processes of the frontal bones, after the manner of Cyclopian monstrosities"*. But the untenableness of this idea will be at once apparent if we refer to the series of frontal bones figured in Plate XXIX. figs. 7, 11, 14, 15, and to the relations of the interocular fibrous septum and olfactory nerves, which here occupy an exactly similar position to what they do in the Turbot (p. 269).

The prefrontals (14' & 14) are fashioned much as in the Halibut; that of the ocular side is pushed forwards somewhat in advance of the other (Plate XXIX. fig. 12).

The *nasal* bone forms a large part of the orbital wall; anteriorly it is much more developed on the side corresponding to the eyeless side of the head. The ridge (*k*) on its anterior surface, on which the intermaxillary cartilage glides, is very obliquely directed towards the eyeless side (Plate XXIX. fig. 12, Plate XXX. fig. 7). Compare this with the direction of the analogous part in the Turbot (p. 271).

Vomer.—The two facets (*p q*, Plate XXIX. fig. 12) on the end of this bone, and on which the heads of the superior maxillary bones glide, are so placed that the line bisecting the angle which they form with each other passes very obliquely to the eyeless side, in the same direction as the articular ridge above on the nasal bone. In consequence of this conformation of the nasal bone and vomer the long axis of the oral apparatus points obliquely to the eyeless side, and when the mouth opens it is protruded in the same direction. (See description of facial bones.)

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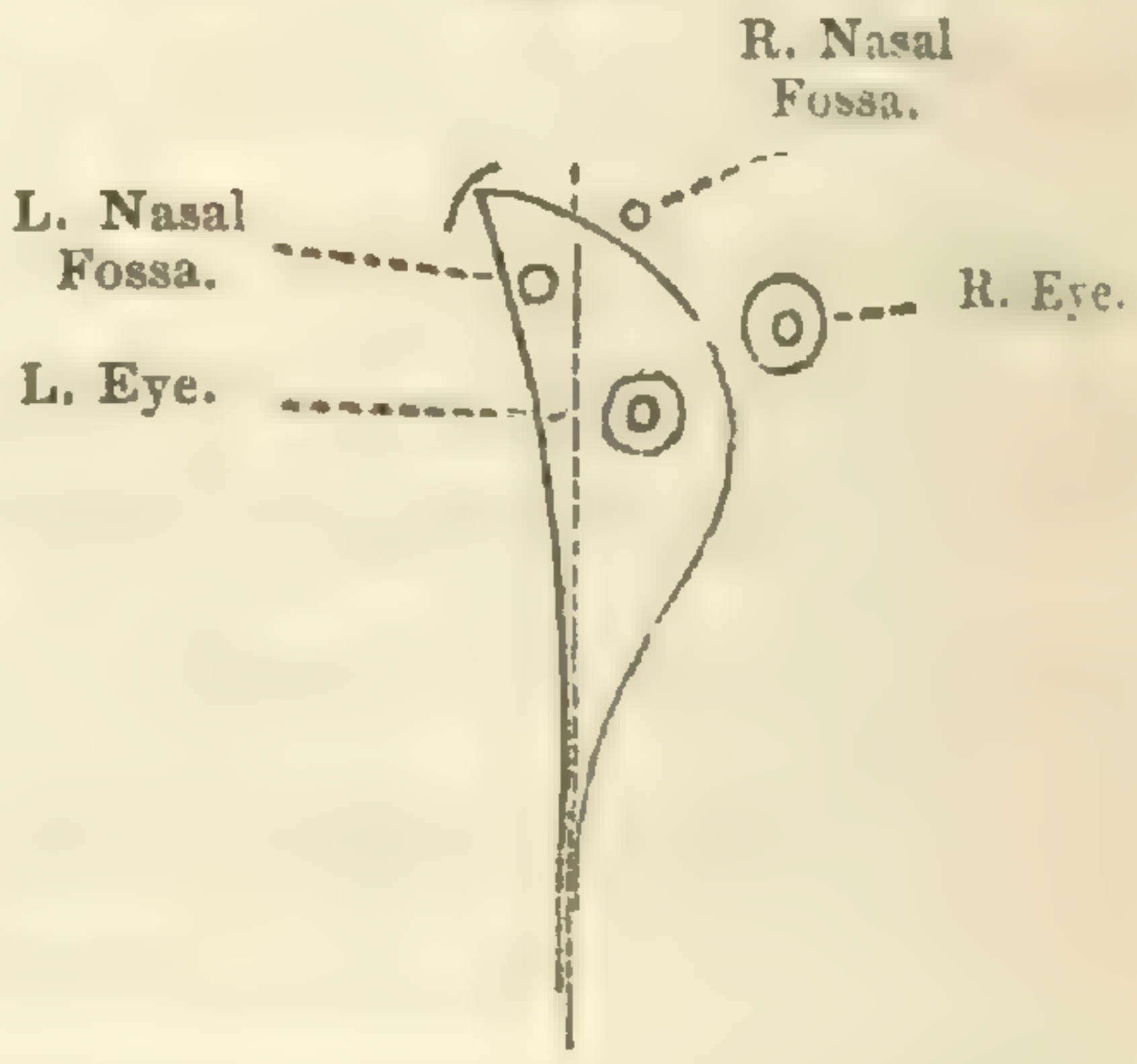
* *Loc. cit.*

The cranium of the Plaice, then, is more unsymmetrical than that of the Halibut in the almost complete non-development of the interocular process of the frontal bone of the eyeless side; and, in consequence, the corresponding process of the other frontal forms almost the whole of the external or lower boundary of the orbit. The nasal bone enters more largely into the boundary of the orbit in front, and the process of twisting of the anterior part of the skull upwards towards the eyeless and downwards towards the eyed side, as well as the bending of the axis of the keel of the cranium towards the eyeless side, has proceeded to a greater extent. In the adjoining diagram the dotted line represents the apparent middle line of the head of a Plaice, the thick black line the axis of the keel of the cranium, and the thin black line the morphological middle line.

Fig. 5.



The changes from the symmetrical type which have taken place in the cranium of the Pleuronectidæ may be summed up in the following propositions :—

1. The mesial vertical plane of the cranium has become inclined over to the now binocular side of the head, very slightly in the posterior part of the cranium, very much in the region of the eyes (so that the original vertical interorbital septum becomes now nearly horizontal), returning in the nasal region nearly to its original vertical position in the Turbot, but never doing so in the Halibut or Plaice.

2. In consequence of this, the middle line of the base of the skull remains still comparatively straight; while the middle line of the upper surface, diverging from the apparent or pseudomesial line, curves round between the eyes (which the turning-over of the mesial plane has of course brought to one side), and returns to the middle in front. Having got in front of the eyes and nasal fossæ in the Turbot, it again coincides, or nearly so, with the apparent middle line; but in the Halibut, and still more so in the Plaice, the apparent and morphological middle lines, if produced, would cross each other.

3. In the anterior part of the cranium, the parts on the eyeless side of the middle line of the *base* are, in all the Pleuronectidæ, more developed than on the ocular side. This is exemplified in the more strong development of the eyeless side of the anterior part of the basi-presphenoid, in the greater breadth of the ala of the vomer on that side, in the greater breadth of the orbitosphenoid, and in the great development of the processes (*c* and *b* in the figures) sent down by the prefrontal to articulate with the vomer and basi-presphenoid. While, on the ocular side, the orbitosphenoid is narrower, the ala of the vomer is smaller, and the prefrontal does not articulate at all with the basi-presphenoid. Not only are those parts, on the eyeless side of the middle line below, more developed than on the ocular side, but their development is in a more vertical direction upwards; so that the whole anterior part of the cranium assumes an appearance as if it

were twisted, up to the eyeless side, down towards the ocular side. In connexion with this, we must notice the greater elevation on the eyeless side of the olfactory foramen, and of the articulation to the cranium of the palatine apparatus and of the anterior suborbital bone.

4. On the top of the head the interocular parts of the frontal and prefrontal bones are more developed on the ocular side. The interocular process of the frontal of the ocular side is always much stouter than that of the other bone, and always articulates with a corresponding process sent back from the prefrontal. But the prefrontal of the eyeless side sends back no process to articulate with the frontal of the same side, whose interocular part, if examined in a series of flatfishes, gets smaller and smaller, till in the Plaice it seems almost gone. The same condition affects the morphologically mesial plate of cartilage forming the anterior part of the interocular septum, which cartilage we have already seen to be chiefly developed on the ocular side.

5. To accommodate the two eyes, now both on one side of the head, the anterior parts of the frontal bones remain as a narrow bar, never widening out into a broad arch as in the Cod and other fishes. Accordingly, to maintain the requisite stability of the cranium, a new bar or bridge of bone is formed (pseudomesial) by the union of a process sent forwards from the anterior external angle of the frontal of the eyeless side with one sent back from the corresponding prefrontal. By means of this bar the upper eye becomes closed round by a bony orbit, whose boundaries in the Turbot consist of the interocular process of the frontal of the eyeless side, the external angular process of the same bone, the external angular process of the corresponding prefrontal, and a small portion of cartilage in front. In the Halibut and Plaice, however, the nasal bone comes to take part in the boundary of the orbit principally by a development from its eyeless side; and in the latter fish, owing to the atrophy of the interocular portion of the frontal of the eyeless side, the corresponding part of the other frontal forms almost the entire external boundary of the orbit.

6. The olfactory foramen and the place of suspension of the anterior suborbital bone are further forward on the ocular side, slightly in the Turbot, to a marked degree in the Halibut and Plaice, in which latter fish the entire prefrontal bone is on this side pushed further forwards. The articulation of the epitympanic bone to the cranium, in the Halibut and Plaice, likewise extends further forward on the ocular side.

7. The axis of the keel of the cranium, pretty straight in the Turbot, points, however, in the Halibut, and still more so in tbe Plaice, to the eyeless side. In the Sole, on the other hand, it is bent with the convexity downwards—a condition apparently connected with the peculiar mechanism of the jaws in that fish.

II. *Bones of the Face.*

Jaws. Palato-suspensory Apparatus. Opercular Apparatus.—The bones of the face in the Pleuronectidæ are also unsymmetrical, but in a much less degree than those of the cranium. Before proceeding to study their asymmetries, however, we must take into account the following circumstances, which seem to act as the conditions on which these asymmetries depend :—

1. The form of the jaws and the direction in which the mouth opens. These conditions vary somewhat in the different Pleuronectidean types. In the Turbot and Brill the jaws are pretty symmetrically conformed, and the mouth opens nearly straight forwards, as in an ordinary fish; whereas, in the Halibut and in the Flounders, the jaws on the eyeless side are considerably stronger and more arched than on the eyed side, and the axis of the mouth, in opening, always tends to point towards the eyeless side. In the Sole, on the other hand, it is by means of the strange conformation of the jaw-bones of the eyeless side that the mouth is rendered chiefly effective on that side, the jaws on the eyed side being even (as is well known) perfectly toothless; and we find, dependent on the peculiar shape of the jaws, variations in the form of the palato-suspensory apparatus of each side, wherein the Sole differs remarkably from the other Pleuronectidæ I have examined.

2. The flattened form of the eyeless side of the fish, and the more arched form of the ocular one.

3. The fact that the cheek of the eyed side must accommodate an eye, while the other side has been relieved of its corresponding one.

4. The greater and more vertical development on the eyeless side of the ala of the vomer, and of the corresponding part of the prefrontal; so that the articulation of the palate-bone to the cranium is higher on the eyeless than on the eyed side.

5. The more anterior position of the parts about the olfactory region which belong to the ocular side, so that the articulation of the palate-bone to the cranium is further forwards on that side. In the Halibut and Plaice this condition affects parts further back (see p. 273), so that the articulation of the suspensory apparatus is also further forwards on the eyed side.

The symmetries of the bones of the face are not much altered in the Turbot and Brill. A greater degree of asymmetry is found in the Halibut and in the Flounders; while the facial bones of the Soles are the most unsymmetrical of all.

Turbot and Brill.—In the Turbot and Brill the mouth looks nearly straight forwards, and, in the movements of opening and shutting, the upper jaw-bones move *en masse* nearly straight forwards and backwards—a circumstance brought about by the nearly straight back-and-forward direction of the ridge on the nasal bone for the intermaxillary cartilage, and by the symmetrical position of the facets on the vomer for the heads of the superior maxillary bones. The intermaxillary and maxillary bones are very nearly alike in size on the two sides; the intermaxillary of the ocular side is a little longer, more arched, and furnished with more teeth than its fellow. The head of the superior maxillary bone of the ocular side has a smaller articular facet for gliding on the vomer. The lower jaw is longer, and somewhat stouter on the eyeless side; the dentition is much the same on both suspensory and opercular apparatus. In the Brill we generally find that the epitympanic and preopercular bones are slightly longer on the ocular side; in the Turbot they are very nearly equal. But in both the Turbot and Brill the operculum and suboperculum are larger on the eyeless side; the interoperculum is also broader, but invariably also much shorter than on the ocular side, because, on the latter side, the articulation of the lower jaw is further forwards. The slightly greater breadth of the opercular bones on the eyeless side, in the Turbot and the Brill, is the only circumstance I know of in the osteology of the face in the flatfishes which shows the least discrepancy with the principles laid down.

Pterygo-palatine Apparatus.—Corresponding with the general flattened form of the whole fish on the eyeless side, and because the cheek of that side has no eye to accommodate, the palate, entopterygoid, and ectoptergoid bones are considerably flatter on the eyeless side; while on the opposite side, to form the floor of a sort of orbit for the lower eye, the entopterygoid bone must arch considerably inwards. In the Turbot and Brill the articulation of the lower jaw to the suspensory apparatus is on much the same level on both sides; but we have seen that in all the Pleuronectidæ the attachment of the palate-bone to the cranium is higher on the eyeless side; therefore the palate and ectopterygoid bones, having more space to traverse on that side, are considerably larger. They are also much stouter than on the ocular side. The entopterygoid bones of both sides are about the same length; but that of the ocular side is rather the broader of the two.

In Plate XXX. figs. 1, 2, the palato-suspensory and opercular apparatus of each side of *Rhombus maximus* are figured, the bones being numbered according to the list given at the end of this essay.

In the Halibut (*Hippoglossus vulgaris*) the facial bones are asymmetrical on the same principles as those which operate in the case of the Turbot above described; but two additional circumstances connected with the jaws exaggerate that asymmetry very considerably.

1. The mouth seems to be twisted on its own axis, so that not only is the articulation of the palate-bone to the cranium higher on the eyeless side, but so is also the articulation of the lower jaw to the hypotympanic. (See Plate XXX. fig. 3, where the end of the cranium, with the attached palato-suspensory apparatus of each side, is seen directly from the front.)

2. The mouth does not open straight forwards, but when the fish gapes it points obliquely towards the eyeless side, the upper jaw-bones, when the mouth opens and shuts, gliding downwards and forwards, upwards and backwards, on the oblique ridge on the nasal bone and the oblique facets on the vomer already described (see p. 274).

Accordingly we find the intermaxillary and maxillary bones a little stouter on the eyeless side; the maxillary of the eyeless side is flatter, and has the tubercle for attachment of the tendon of the retractor maxillæ muscle much larger, and situated lower down, than in the bone on the other side; the convex facet on the head of the bone for gliding on the vomer is likewise larger. The lower jaw is a little longer, and considerably more arched on the eyeless side; its dentary bone is likewise armed on this side with a greater number of teeth.

Suspensory and Opercular Apparatus.—As in the Turbot and Brill, the epitympanic bone is larger on the eyed side; and the disproportion between the bones of the two sides is still greater, because the articulation of the lower jaw is lower down on the ocular side. And because that articulation is also further forwards on the ocular side, we have the mesotympanic, pretympanic, and hypotympanic longer on this side,—the disproportion being, however, least marked in the case of the mesotympanic. But in all the three bones there would have been still more disproportion, were it not that the articulation of the epitympanic to the cranium extends further forwards on the eyed side (see p. 275). And because the articulation of the palate-bone to the cranium is further forwards on the ocular side, we have the entopterygoid slightly longer on that side. But that articulation of the palate-bone being much higher on the eyeless side, we have an increase in length and stoutness of the palate and ectopterygoid bones of the eyeless side, which would have been still more marked, were it not that the articulation of the lower jaw to the hypotympanic is higher on the side in consideration.

Opercular Apparatus.—Both on account of the more arched form of the eyed side of the head, and because the articulation of the epitympanic advances on this side further forwards, so that the opercular bones have more space to cover, we find on the eyed side the operculum and suboperculum larger in every way than their fellows of the eyeless side. And because of the more anterior position of the articulation of the lower jaw on the ocular side, we find the interoperculum longer on the same side. A combination of these two circumstances, together with the fact that the articulation of the lower jaw is lower on the eyed side, renders also the preopercular bone of the eyed side larger in every way, the increase in length being, however, most marked in its horizontal ramus.

In Plate XXX. fig. 3, I have figured the cranium and palato-suspensory apparatus of the Halibut, seen directly from the front. Observe, on the eyeless side, the more elevated position of the olfactory foramen, of the attachment of the palate-bone to the cranium, and of the trochlear articular surface for the lower jaw, and the general flatness of the palato-suspensory apparatus.

In the Plaice (*Platessa vulgaris*) the facial bones are constructed and arranged on exactly the same principles as those in the Halibut last described, but with some exaggeration of the asymmetries. Indeed when a Plaice gapes, its mouth turns round towards the eyeless side in a most remarkable manner; and that side being undermost when the fish is swimming in its natural position, I suppose it is thereby better enabled to pick up from the sea-bottom the small shell-fish, crustacea, and sandstars which are always abundantly found in its stomach when opened. The principles on which this is effected are the same as those on which the minor degree of the same sort of obliquity depends in the Halibut, and may be thus enunciated.

1. The very oblique direction of the articular ridge on the front of the nasal bone, on which the cartilage supporting the intermaxillary bones glides. Its direction necessitates these bones, when the mouth opens, to move downwards, forwards, and to the eyeless side.

2. The great obliquity of the axis of the two facets on the front of the vomer, on which the heads of the superior maxillary bones, along with the interposed fibro-cartilaginous disks, glide. That of the ocular side looks forwards rather than laterally; and a line bisecting the angle formed by the two facets would pass obliquely to the eyeless side. Accordingly, in their movements, the superior maxillary bones follow the intermaxillaries in passing towards the eyeless side when the mouth opens.

3. The articulation of the lower jaw to the suspensory apparatus is further forwards

on the ocular side, so that the direction in which the lower jaw works is towards the eyeless side. (See Plate XXX. fig. 6.)

4. The conformation of the jaws themselves is also very important in connexion with the obliquity of the mouth. The superior maxillary bone of the eyed side is to some extent smaller than that of the eyeless side. But the intermaxillary of the eyed side is very much smaller than its fellow; its ascending process is at a more obtuse angle to the body of the bone, which bears only 4–7 teeth, while the bone of the eyeless side, stout and strong, with its ascending process, set at nearly a right angle to its body, is set with 25–30 teeth or more. The *lower jaw* of the ocular side, rather flat, is shorter than that of the eyeless side; its dentary bone bears, like the corresponding intermaxillary, only 4–7 teeth. The longer lower jaw of the eyeless side has, on the other hand, its dentary part much curved and set with 25–35 teeth; so that not only does the mouth, when opened, point to the eyeless side, but that side of the mouth is more arched and prominent, even when shut, and contains almost all the teeth.

In Plate XXX. fig. 4, is figured the palato-suspensory and opercular apparatus of the ocular side of the Plaice, seen laterally; and in fig. 5 that of the eyeless side. Fig. 7 represents the cranium and palato-suspensory apparatus of both sides, seen exactly from the front; while fig. 6 gives a view of the lower jaw and opercular apparatus of both sides, seen from below.

III. *On the Superficial Face-bones and on the Distribution of the Slime-canals.*

We have still to consider whether there be in the Pleuronectidæ any representatives of the supratemporal and suborbital ranges of bones, and of those bones called by Cuvier "nasal," by Owen "turbinal."

In osseous fishes generally these bones are intimately connected with a system of dermal tubular organs, the "mucus-" or "slime"-canals; and hence it will be necessary for us also to study the relations and arrangement of these canals in the Pleuronectidæ.

The arrangement of these canals on the heads of osseous fishes follows, on the whole, a very definite plan*; and if we adhere to the Cod as our standard of comparison, we shall find how completely the plan of the arrangement of the mucus-canals in the Pleuronectidæ corresponds with that of the same organs in the Cod, and how that plan has been modified entirely in accordance with the theory of the Pleuronect cranium already given.

The Symmetrical Arrangement in the Cod.—The plan of this arrangement I have represented in a diagram (Plate XXXII. fig. 1). The mucus-canal of the lateral line (*a a*), supported all the way along by peculiarly modified scales, extends on to the head, runs along grooves in the mastoid, postfrontal, and frontal bones, and then, lodged in the grooved turbinal (19), terminates near the end of the snout, and to the inner side of the nostril. On the surface of the frontal bone it forms a commissure (*e*) with its fellow of the opposite side. On its way, it gives off the following branches:—

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* The arrangement of these canals in the symmetrical fish has been described by Monro in his work, 'The Structure and Physiology of Fishes explained and compared with those of Man and other Animals,' Edinburgh, 1785; and also by Stannius in a paper, "Ueber die Knochen des Seitenkanals der Fische," Froriep's Neue Notizen, Bd. xxiii. S. 97–100 (April 1842).

1. The supra-temporal branch (*b*) at the back of the head, supported by the supra-temporal bones (72), indicated in the diagram in outline.

2. The operculo-mandibular (*c c*), running in a groove, first in the præoperculum and then along the lower jaw, where it ends near the symphysis.

3. The suborbital (*d*), supported by the suborbital bones (73′), running along beneath the eye, and terminating near the end of the snout, close to the end of the main canal, but to the outer side of the nostril.

The Arrangement in the Pleuronectidæ.—In the genus *Rhombus* (Diagram, Plate XXXII. fig. 2), the lateral canal of the eyed side (*a′ a′*) pierces the suprascapular bone (50), then enters the first supratemporal bone, which bifurcates. The canal coming from the lower branch of the latter bone then enters the mastoid, passes from it to the frontal, and, arriving at the posterior margin of the orbit, gives off a branch (*e*) to communicate with the main canal of the opposite side. It then pursues its way in the stout interocular process of the frontal, emerges from it at the anterior margin at the orbit, and ends, to the inner aspect of the nasal fossa of the ocular side, in a curved tubular ossicle (19′), which we at once recognize as the "turbinal."

This canal gives off, on its way, the following branches, as in the Cod:—

1. The supratemporal (*b′*), issuing from the upper limb of the tubular bifurcated first supratemporal bone, proceeds, supported in a series of about sixteen little tubular ossicles constituting the rest of the supratemporal range, towards and along the base of the cephalic end of the dorsal fin, to beyond the middle of the upper eye, where it ends. These little bones have been indicated in the diagram by simple outline (72).

2. The operculo-mandibular (*c′*), given off while the main canal is still in the mastoid bone, runs in a tube hollowed out in the præoperculum and lower jaw-bones, and ends near the symphysis of the jaw.

3. The suborbital branch (*d′*), given off opposite the origin of the commissural branch (*e*) already referred to, runs in a series of about nine minute tubular ossicles (73′) under the lower eye, and ends, to the outer side of the nasal fossa of the ocular side, in an ossicle much larger than the rest, which is suspended to the prefrontal bone of the same side. The series of little ossicles is the suborbital range of bones; the larger anterior one is of a triangular shape, elongated, and with the apex directed posteriorly; on its surface is a tube which lodges the terminal portion of the mucus-canal. This terminal portion, however, seems to be isolated and distinct from the rest of the suborbital canal.

On this side, the arrangement is very plain, the main canal curving round between the eyes, following the morphological mesial line, while the supratemporal branch proceeds forwards according to the apparent or pseudomesial line, along with the dorsal fin.

On the eyeless side the lateral canal is similarly related to the suprascapular and first supratemporal bones, and to the mastoid. The supratemporal branch proceeds forwards, with the dorsal fin, in the pseudomesial line; and the operculo-mandibular branch is given off and pursues its course exactly as on the ocular side. But the main canal having entered the frontal bone, and arrived at the posterior margin of the orbit, it gives off a commissural branch to join that of the other side (*e*) already mentioned. It then passes between the eyes, lodged in the slender interocular process of the corresponding frontal bone (eyeless side), till it ends in front of the orbit, and to the inner side of the nasal fossa of the eyeless side, in a "turbinal" ossicle (19), which is longer than its fellow of the opposite side.

We have thus the main stem of the mucus-canal of the eyeless side also following the morphological middle line of the top of the cranium, crossing the pseudomesial line beneath the cephalic part of the dorsal fin, and beneath the supratemporal canals of *both* sides, and passing between the eyes side by side with its fellow of the opposite side, and with which, as in the Cod, it is connected by a transverse commissure. This arrangement we may also regard as additional evidence that the "interocular" bar in the Pleuronect cranium is the only and entire homologue of the arch of the frontal bone in the Cod and other fishes.

But where are the suborbital canal and chain of bones of the side under consideration? We have seen that a mucus-canal, contained in a range of minute bones (*b′ b′*), lies alongside the upper eye; but we have also seen that this is the supratemporal branch of the eyed side. We must accordingly look for some other. From the point behind the orbit where the main stem of the eyeless side gives off its commissural branch, is given off in the opposite direction a branch (*d d*) running at first a little backwards, till it emerges from the frontal bone, when it turns forwards and proceeds, in the skin of the eyeless cheek, pretty closely alongside the pseudomesial bar of the cranium, till it ends in the outer side of the nostril of the eyeless side. This canal, enclosed in seven tubular ossicles (73′), of which the anterior one is largest, is undoubtedly the suborbital of the side on which it is found, and that which should appertain to the upper eye of the flatfish, but situated on the other side of the head from that on which its eye is now found; and not only so, but between it and its eye we find the pseudomesial bar of the cranium, the cephalic extremity of the dorsal fin, and the supratemporal canals and ranges of bones of both sides. In fact, the one eye has passed over to the now binocular side of the fish, leaving its suborbital range behind it, while the other structures before mentioned have got interpolated between the dorsal fin and the supratemporal canals proceeding forwards from behind, the pseudomesial bar being formed partly by a process sent back from the prefrontal, and by one sent forward from the frontal bone of the now eyeless side. It must be observed, however, that this suborbital canal of the eyeless side, though it has not followed its eye completely round, is yet situated much higher on the side of the head than its fellow opposite; indeed, as far as it is concerned, the turning-process has proceeded so far, and then become arrested.

In the Halibut, in which I have examined these canals with some care, the arrangement is much the same. We find the main canal of each side curving round between the eyes, one contained in the interocular process of each frontal bone, in the same manner as is represented in the diagram of the Turbot (Plate XXXII. fig. 2). The main canal of the eyeless side, however, here pierces also the nasal bone, as shown by the two little openings in the bone 15 (Plate XXIX. fig. 10), thus confirming what I have already stated (page 274), that that part of the nasal bone entering into the boundary of the orbit in the Halibut and Plaice is a development from the part of the bone appertaining to the eyeless side.

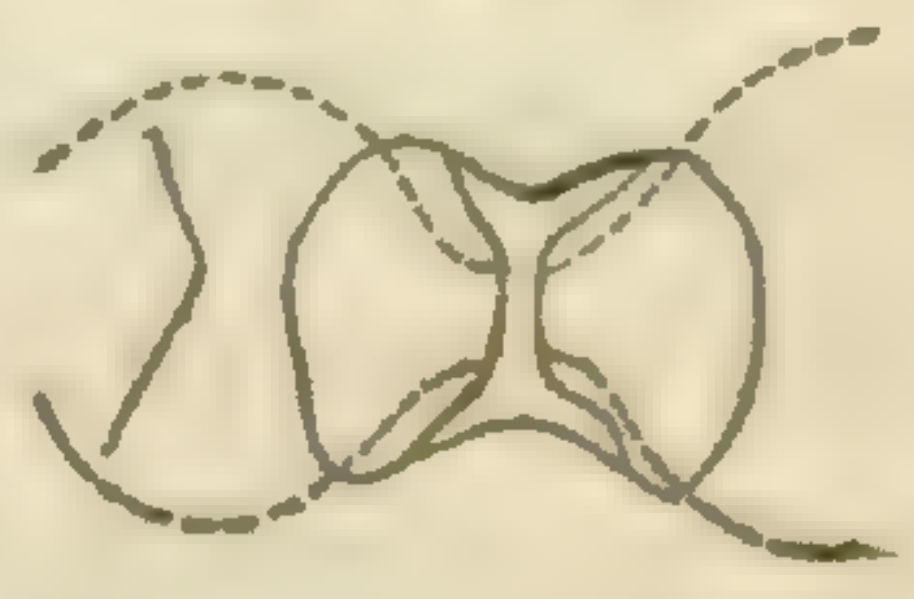
In Plate XXXI. fig. 1, are represented the superficial face-bones on the eyed side of a Halibut; in fig. 2, those of the eyeless. On the ocular side observe the suborbital range (73'), extending along in direct relation to its eye (the lower one); but with this peculiarity, that the anterior suborbital bone(73' a), stout, oblong, and pointed at both ends, is separated from the rest by an interval, and that the mucus-canal does not extend on to it, but stops short at the preceding little tubular ossicle. Observe also the supratemporal range (72) following the direction of the dorsal fin, and extending along the upper side of the upper eye like a pseudo-suborbital range for it. The "turbinal," or *os terminale* (19'), is also seen, and above it, lying on the top of the head, is seen the corresponding ossicle of the eyeless side (19). On the eyeless side (fig. 2) observe the supratemporal range (72), following the direction of the dorsal fin; and the suborbital range, lying on the cheek higher up than the corresponding range on the other side, but with no eye visible in relation to it. On the top and front of the snout is again seen the turbinal (19) of this side. The anterior suborbital of the ocular side is a stout oblong bone, pointed at both ends, and articulated to a process (+) of the prefrontal, opposite the olfactory foramen, and is also closely related to the anteriorly projecting process of the palate-bone. As already stated, it is not perforated by any mucus-canal. That of the eyeless side (73', fig. 2) is similarly related to the corresponding prefrontal and palate-bones, but is smaller, flatter, and perforated by the mucus-canal, which traverses the rest of the range. The turbinal of the ocular side is larger than the opposite one, is curved, flattened, and contains a branching canal. All the rest of the superficial face-bones of the Halibut are very delicate tubules, often showing lateral branchlets, through which little ducts pass to ramify in the skin and open on its external surface. As they get smaller towards the ends of the several ranges, they often cease to be complete tubes, and appear like little scales with the edges folded up. As to number, these little bones are apt to be irregular. The supratemporal ranges generally consist of from twenty-two to twenty-five ossicles each, and the suborbital of the ocular side of from seventeen to nineteen; but two often supply the place of one. The suborbital range of the eyeless side, however, consists pretty constantly of nine bones—about one-half the number found on the opposite side.

In the Plaice the arrangement has undergone a little modification (see diagram, Plate XXXII. fig. 3). The canal of the ocular side, as usual, extends between the eyes, and ends in its turbinal ossicle. The operculo-mandibular, the suborbital, and the supratemporal branches are on both sides, similar to those in the Halibut; and so is also the cross commissure. But as the interocular process of the frontal bone of the eyeless side is non-developed (p. 275), the main mucus-canal of that side no longer extends between the eyes, but stops short at the commissure. Anteriorly we find, to the inner side of the nasal fossa of the eyeless side, a minute turbinal ossicle, containing as it were a little follicle, with two openings on the skin, this little mucus-cavity being in fact the remnant of the main canal of the eyeless side, but detached altogether from the rest by the atrophy or non-development of the intermediate portion. (For more details I refer the reader to Plate XXXI. figs. 3 and 4, and to the diagram, Plate XXXII. fig. 3.)

This arrangement prevails in the genus *Platessa*, the interocular portion of the mucus-canal of the eyeless side having completely disappeared in all the species I have examined. In *Platessa limanda* the turbinal ossicle of the eyeless side is about as small as in the Plaice; in *P. flesus* it is a little larger.

But the most remarkable condition of the mucus-canals in the genus *Platessa*, and indeed in the whole group of flatfishes as far as I know, is that seen in *Platessa pola**. In this fish we have on the ocular side (Plate XXXI. fig. 5) nothing very peculiar to notice: the arrangement seems to be just as in the Plaice, excepting that there is no cross commissure. The suborbital and supratemporal bones are very small and delicate, and generally have not closed over so as to form complete tubules. But on the eyeless side the mucus-canals are dilated into large, circular, flattened ampullæ, the outline of which I have given in Plate XXXI. fig. 6. These ampullæ are twenty-six in number; six of these are situated on the main trunk, two on the detached nasal portion, four on the supratemporal branch, eight on the operculo-mandibular, and six on the suborbital. The supporting bones of this system are also peculiarly modified: the suprascapular, mastoid, frontal, and preopercular bones, also the lower jaw, are furnished with excavations for the support of the ampullæ belonging to the main canal and the opercular mandibular branch. The supratemporal bones (72) five in number, are very delicate laminæ of bone pierced with many minute holes (when macerated), their lateral edges folded in, and connected by a bridge across the middle, where the whole bone is constricted. The hollow of each bone is therefore hourglass-shaped, and takes part in the support of two ampullæ, which communicate by the narrow part passing beneath the bridge aforesaid, as in the adjoining diagram. The *os terminale*, or turbinal, has the same structure, as likewise have the five suborbitals, except the anterior one, which is somewhat trigonal, and takes part in the formation of three ampullæ. I have said that there is no cross commissure; the branch (*e*), on the ocular side, analogous to the commissural branch in the Plaice, ends almost immediately in a blind point on the eyeless side; the anterior ampulla on the main canal, indicated in dotted outline in fig. 6, is situated more deeply than the rest, being partly overlapped by the ampulla behind, and by the anterior two supratemporal ones in front. This arrangement may be regarded as an indication of a commissure, but none is really effected.

Fig. 6.



IV. *Vertebral Column.*

The vertebral column in the Pleuronectidæ is usually supposed to be quite *symmetrical.* In some it is not so, however, as I will presently point out.

The vertebral column of the Plaice displays the following peculiarities:—

1. The mesial vertical plane of the vertebræ is curved, the convexity being toward the eyed side, the concavity towards the eyeless. This is most strikingly seen in the anterior vertebræ, such as the first, which I have represented (Plate XXXII. fig. 6) as seen from

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* The ampullated condition of the mucus-canals on the eyeless side of the head in *P. pola* has been already noticed by Dr. M‘Donnel in the ‘Trans. Royal Irish Academy,’ vol. xxiv. Science, 1862. On the morphological arrangement of these ampullæ, he has, however, made no observations.

the front. The spinous process is seen to be strongly bent over towards the eyeless side; a similar curve is seen affecting the middle line of the posterior aspect of the cranium (fig. 5).

This condition gradually diminishes posteriorly; but throughout the entire series of caudal vertebræ the superior and inferior spinous processes are set at a slight angle to each other, consequently the entire skeleton of a Plaice is convex on the ocular surface, concave on the eyeless.

2. The transverse processes of most of the abdominal vertebræ are unsymmetrical, slightly in their place of origin on each side from the bodies of their vertebræ, considerably so as regards the direction in which they proceed. Seen from below, these processes on the eyeless side arise a little further forwards on the bodies of their vertebræ, and project nearly directly outwards, sometimes even a little anteriorly; while those of the ocular side are directed considerably backwards. The four anterior vertebræ and the thirteenth (last abdominal) are pretty exempt from this condition; but it affects the intermediate ones pretty strongly. Plate XXXII. fig. 8, shows the under aspect of the series of abdominal vertebræ in the Plaice, and how a line joining the tips of the transverse processes of one of the middle vertebræ of that series passes very obliquely across the long axis of the column. Again, when seen from before backwards, the transverse processes of the abdominal vertebræ project more vertically downwards on the eyeless than on the eyed side—a circumstance in accordance with the more flattened shape of the fish on the former side. The transverse processes of the caudal region, in accordance with the well-known greater development of the lateral muscle on the ocular side, are also more prominent on the same side.

The vertebræ of the Halibut present the same sort of asymmetries which we have observed in the Plaice: some differences are to be observed in the Turbot and Brill. Here asymmetry is chiefly to be seen in the transverse processes, which agree with those of the vertebræ of the Halibut and Place in this, that those of the abdominal region are more directed vertically downwards on the eyeless side, and those of the caudal region are on the same side less prominent. But, when looked at from above or below, the transverse processes in the abdominal region are seen to project more posteriorly on the eyeless side—a condition exactly opposite to that found in the Plaice.

V. *The Dorsal Fin.—Conclusion.*

The dorsal fin, it is well known, extends in all the Pleuronectidæ all along the back, and advances forwards on the top of the head. Its advance on the head depends on two circumstances.

1. A more and more oblique direction forwards of the anterior interspinous bones, till the first one, becoming horizontal or nearly so, carries the anterior rays of the fin to opposite the middle of the upper eye (*Hippoglossus Platessa*) or to beyond both (*Rhombus Solea*, &c.).

2. A bodily advance forwards of these interspinous bones themselves on the top of the cranium.

In the Sole only about five interspinous bones arise on the top of the cranium, and their places of attachment proceed no further forward than the supraoccipital bone. But the anterior one is of considerable length, and, directed forwards, curving also a little downwards, carries the anterior rays of the dorsal fin in front of the eyes and even of the mouth.

In the Halibut and Plaice there are six to eight of these bones on the top of the skull. In their origins they have advanced from the supraoccipital bone on to the frontal of the eyeless side; but the anterior one is not so long proportionally as in the Sole, and only carries the first rays of the fin to opposite the middle of the upper eye.

In a specimen of the Brill, I found ten interspinous bones on the upper aspect of the head, their cranial attachments advancing over the supraoccipital and over the frontal of the eyeless side, till the anterior one takes its origin even from the prefrontal of the same side. This anterior interspinous bone carries the first rays of the dorsal fin to beyond the eyes, but not so far as in the Sole.

We thus find that in the Brill and in the Sole the dorsal fin has advanced along the head further than in the Halibut and Plaice: in the Sole this has been effected by an excess of the first method of advance, in the Brill by an excess of the second. The direction in which the fin advances is nearly straight forwards, in the same straight line as the middle line of the back, inclining only very slightly towards the eyeless side. It thus completely disregards the morphological middle line of the top of the head, being supported anteriorly on the pseudomesial bar of the cranium, and on the ridge extending on to this bar from the centre of the supraoccipital bone. A part of the lateral muscle passes on each side on to the top of the head, along with the dorsal fin, and is arranged alongside that structure in equal disregard of the morphological middle line, as likewise are the supratemporal canals.

Now, of this remarkable circumstance, there are only two explanations possible. Either the dorsal fin is in its original morphological position*, and the upper eye has passed under it, or the fin has advanced forwards from behind after that eye has turned over from the side to which it originally belonged. To the latter view, which is indicated in the paper by Van Beneden already quoted, I must, for the following reasons, give in my adherence.

1. The structure of the cranium shows clearly that the transference of the upper eye is connected with the deviation, in the ocular region, of the original middle line of the top of the head over to the now binocular side, and that the eye in question preserves its morphological relations to the frontal bones and the neighbouring structures quite intact, the view that it has migrated beneath any of the parts of the skull in the manner held by Rosenthal and Steenstrup being quite untenable. Now, the structures accompanying the cephalic end of the dorsal fin showing the same disregard of the morphological

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* This was Meckel's opinion, as may be gathered from the following extract from his 'Comparative Anatomy.' Speaking of the interspinous bones on the top of the cranium in the Pleuronectidæ, he says, "This disposition is extremely interesting; it helps to establish the analogy of the cranial bones with the vertebræ; these accessory rays are placed in fact on the occipital and parietal crests in the same way as those of the trunk are situated over the superior spinous processes." (*Op. cit.* French edition, p. 312.)

This passage would indicate that Meckel had quite overlooked the fact that those cephalic fin-rays are not placed over the morphological middle line.

middle line as the fin itself, it is hardly possible to imagine that middle line and one eye migrating beneath the superimposed parts without the symmetry of the latter being affected, had they been in their present position at the time that the supposed migration took place.

2. All those parts accompanying the dorsal fin in the head show traces of having come from behind. That part of the lateral or body-muscle, which lies on the top of the head consists of the anteriorly reflected portions of muscle-segments posterior to the cranium. The nerves supplying the fin-rays and muscles in this region are derived from the dorsal branches of the first three or four spinal nerves, which turn forwards over the head from behind. The supratemporal mucus-canals and bones, which, commencing posteriorly, also proceed forwards in defiance of the morphological middle line, are supplied by branches of the vagus nerve, which of course also turn round from the back of the skull and run forwards. Lastly, the blood-vessels supplying the fin-rays, &c., on the top of the head accompany the branches of spinal nerves already mentioned, and proceed to their destination from behind forwards.

3. The embryological observations of Van Beneden seem to favour the same view; and I have already referred (p. 264) to the paper wherein he describes a young Pleuronect in which the two eyes were still one on each side, and the dorsal fin only yet descended to the middle of the cranium. To this observation I may add one of my own. In the summer of 1863 I obtained, in dredging over a sandy bottom in the Frith of Forth, three young Pleuronectidæ, each about half an inch long, and apparently belonging to the genus *Platessa*. In two of them the eyes and dorsal fin were conformed as in an adult Flounder, but in the third (the anterior part of which is figured, Plate XXXII. fig. 9, magnified five diameters) one eye was nearly on the middle line, with, as in M. van Beneden's specimen *, the dorsal fin stopping short behind it.

4. The structure of certain malformations occasionally found amongst flatfishes also confirms the view I have adopted. These monstrosities are specimens of Pleuronectidæ where the upper eye is found more towards the top of the head than usual, the dorsal fin not being fixed down by the side of it, but projecting above it, supported on a free pointed process. Many of these specimens have been already recorded†. The most remarkable case I am acquainted with is one described and figured by Schleep ‡, occurring in a Turbot, which he calls *Pleuronectes maximus duplex*, thinking that possibly it might be a distinct species. Here the two eyes are still one on each side of the head; the right one, however, is higher than the left, and seems just about to make the turn, while the anterior part of the dorsal fin projects over the eyes supported on a free pointed process.

I have seen cases of this condition both in the Turbot and Flounder (*Platessa flesus*), though not in so exaggerated a degree as in Schleep's specimen. In Plate XXXII. figs. 8–9, are represented both sides of the head of such a specimen of *P. flesus*, the mucus-canals being indicated by the shading in horizontal lines. The upper or left eye is seen to be situated on the top of the head, having, we may say, just turned the corner and no more; while the dorsal fin presents the appearance already referred to. Here also, on the eyeless side, the relation of the suborbital canal to the upper eye is very obvious, the fin not having become interpolated between them as in the perfectly developed flatfish.

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* *Loc. cit.*

† See Yarrell's 'British Fishes,' vol. ii.

‡ Oken's 'Isis,' 1829, S. 1049.

These monstrous Pleuronectidæ may be accordingly defined as flatfishes in which the turning-round of the upper eye to the other side of the fish has been arrested when it has got about the middle of the top of the head, and in consequence the passage forwards and tying down of the anterior part of the dorsal fin has also been stopped, or obviously it would cross over the eye instead of passing by the inner side of it, as in the normal flatfish. It accordingly projects upwards and forwards on a pointed process overhanging the eye, as in the specimen figured. It is worthy of remark that all those abnormal specimens are equally coloured on both sides, as if the animal, not having perfectly acquired the characteristics of a flatfish, swam with either of its sides upwards and exposed to the light at pleasure. In the case of Turbots affected with this condition, the bony tubercles also, usually characteristic only of the ocular side, are found equally distributed on the eyeless one.

As we must consider those monstrosities to be dependent on arrested development, the only developmental circumstances which we can safely infer from the appearances presented are, that the upper eye turns round on the top of the head, and that then the dorsal fin advances past it.

But the young *Plagusiæ* figured by Steenstrup would seem to contradict directly the above-advocated theory, and prove that the upper eye gets to its present position by passing beneath the dorsal fin. In some of his specimens the transposition seems never to have taken place at all; but the one which seems most fully to justify his views is one where the animal seems to have three eyes, the eye of one side projecting also through a little fissure above that of the other side, which side becomes thus binocular. This appearance is so striking that one might readily be excused in thinking with M. Steenstrup, " Can we imagine a more striking demonstration of the passage of the eye across the head than an eye arrested in this position?" Another specimen described by him has an eye on each side of the head, but above the left eye is a little slit where the other should appear.

Although it must at once be acknowledged that these observations are very remarkable, and not to be cast aside merely because they do not tally with our preconceived theories, yet it seems to me that considerable research is still required before we can accept these specimens as representing the normal process of development in all the Pleuronectidæ; for the structure of the head of the adult flatfish seems to me most conclusively to prove that the upper eye does not pass beneath or through any part of the bony cranium, and that the dorsal fin and its associated structures advance from behind, while the structure of the well-known " monsters," and the observations of Van Beneden and also of myself on young Pleuronectidæ, certainly indicate that in the genera *Rhombus* and *Platessa*, at least, the dorsal fin advances after the upper eye has turned round on the top of the head.

But M. Steenstrup's strange specimens certainly open up the question whether there be any group of flatfishes in which, in the normal course of development, the dorsal fin extends forwards, and bridges over the upper eye before it has completed or even commenced its turn. But, before a conclusive answer can be given to that question, much more extensive observations on Pleuronectidean embryology are necessary.

Concluding Note.

Since writing the foregoing Memoir, my attention has been drawn to a paper, on Steenstrup's views on the obliquity of Flounders, by Prof. Wyville Thomson, in the 'Annals and Magazine of Natural History' for the present month (May 1865). As far as can be gathered from the abstract of Prof. Steenstrup's original paper, which Prof. Thomson has in the present communication afforded us, the learned Danish naturalist attempts no explanation on developmental principles of the singular "double" monstrosities occurring in flatfishes, and also questions the accuracy of Van Beneden's observations already quoted. In his critical remarks on this paper, Prof. Thomson has expressed the same views as to the morphological relations of the eyes to the two frontal bones, and as to the constitution of the pseudomesial beam or bar of the cranium, as those advocated in the preceding pages, though so far agreeing with M. Steenstrup as to consider that the "eye of the blind side actually passes from its own side of the head to the other side—at all events under the integuments and under the subcutaneous tissues, which contain the rudiments of the dermal bones forming the support of the anterior border of the dorsal fin, if not actually through the head itself."

In justice, however, to myself I may be permitted to state that the Memoir just concluded is hardly altered from that which formed my Graduation Thesis at Edinburgh in 1862, and which may be consulted in the library of the University there, where it is deposited *. The same views were also expressed by me in a criticism of Prof. Steenstrup's paper in the 'Annales,' read by me before the Royal Physical Society of Edinburgh, on the 25th of January of the present year, and about to be published in the forthcoming part of its 'Proceedings.'

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* The Medical Faculty of the University of Edinburgh awarded a gold medal to this Thesis, 1st August, 1862.

EXPLANATION OF THE PLATES.

In all the following illustrations, the same numbers apply to the same bones. They are also the same as those by which Prof. Owen has distinguished the various bones of the fish's head in his 'Lectures on Comparative Anatomy.'

1. Basioccipital.
2. Exoccipital.
3. Supraoccipital.
4. Paroccipital.
5. Basi-presphenoid.
6. Alisphenoid.
7. Parietal.
8. Mastoid.
10. Orbitosphenoid.
11. Frontal.
12. Postfrontal.
13. Vomer.
14. Prefrontal.
15. Nasal.
16. Petrosal.
17. Sclerotal.
19. Turbinal.
20. Palatine.
21. Maxillary.
22. Inter- or pre-maxillary.
23. Entopterygoid.
24. Pterygoid.
28 *a*. Epitympanic.
28 *b*. Mesotympanic.
28 *c*. Pretympanic.
28 *d*. Hypotympanic.
29. Articular.
30. Angular.
32. Dentary.
34. Preopercular.
35. Opercular.
36. Subopercular.
37. Interopercular.
44. Branchiostegal.
50. Suprascapular.
51. Scapula.
52. Coracoid.
72. Supratemporal.
73′. Suborbital.

PLATE XXIX.

In all these figures the primordial cartilage is shaded in with horizontal lines. The numbers refer to the list already given.

Figs. 1–7. Illustrations of cranium of Turbot (*Rhombus maximus*).

Fig. 1. The cranium seen from above.

A. The piece of cartilage supporting the four bones of the nasal end of the cranium, and forming the anterior part of the septum between the eyes.

B points to the orbit, bounded on one side by the interocular process (*m*) of the frontal of the eyeless side (11), and on the other by the process (*f*) of the prefrontal of the same side (14).

c′ c. The two olfactory foramina.

11′. Frontal bone of the ocular side.

11. Ditto of the eyeless side.

14′. Prefrontal of the ocular side.

14. Ditto of the eyeless side.

e. A process on each prefrontal, to which the anterior suborbital is attached.

f. A process of the prefrontal of the eyeless side, sent back to join the process (*n*) of the corresponding frontal. Thus is the pseudomesial bar formed, and the orbit bounded on the inner side.

m′. Interocular process of frontal of ocular side.

m. Ditto of eyeless side.

i. Process on the nasal bone above the apparatus of the jaw.

k. Process on the nasal bone on which the intermaxillary cartilage glides.

β. The ridge or spine of the supraoccipital bone, proceeding forwards in the pseudomesial line and a little towards the eyeless side.

The dotted line M L represents the direction of the morphological mesial line.

Fig. 2. Under surface of the same cranium.

D. Cotyloid cavity for the rounded head of the epitympanic bone.

a. A process of the prefrontal of the eyed side, sent between the eyes to articulate with the interocular process (*m*′) of the corresponding frontal.

b. A process sent downwards and backwards by the prefrontal of the eyeless side to articulate with the basi-presphenoid.

Fig. 3. Upper aspect of the same cranium, the two frontals, the two parietals, and the anterior part of the supraoccipital being removed. The interior of the brain-cavity is thus partially exposed; a bristle is passed through each olfactory foramen in the direction pursued by the olfactory nerve.

g. A process of the cartilage (A) supporting the interocular process of the frontal of the ocular side, and the corresponding process (*a*) of the prefrontal of the same side.

h. A smaller process of the same cartilage, supporting the interocular process of the frontal of the eyeless side.

10, 10. The two orbitosphenoids, their cartilaginous tips pointing over towards the ocular side.

Fig. 4. Anterior part of another cranium seen from above, but slightly tilted round towards the eyeless side. The frontal bones are removed, and two black bristles are passed, one through each olfactory foramen, as in fig. 3.

Fig. 5. Same part of the cranium, but drawn from another specimen, seen from the ocular side, though slightly tilted round towards the eyeless one. A bristle is passed through the olfactory foramen of the eyeless side.

Fig. 6. The same, seen from the eyeless side. The lettering in this and the two preceding figures is explained under figures 1, 2, 3, and 17.

Fig. 7. The two frontal bones of the Turbot.

11′. That of the ocular side: *m*′, its interocular process.

11. That of the eyeless side: *m*, its interocular process; *n*, its external angular one. The position of the eyes is diagrammatically indicated in dotted outline.

Fig. 8. Upper surface of the cranium of the Halibut (*Hippoglossus vulgaris*). The orbit is here on the right side, instead of on the left as in the Turbot.

A. Cartilage of the nasal part of the cranium, as in the Turbot.

g. A notch in the cartilage, into which a laminar projection from the interocular process (*m*′) of the frontal bone of the ocular side is received.

h. A smaller notch in advance of the other, which receives a similar lamina developed on the end of the more slender interocular process (*m*) of the other frontal.

p q. Two facets on the end of the vomer; that of the eyeless side (*p*) is larger and looks more laterally than the other (*q*). On these two facets move the heads of the corresponding superior maxillary bones, with the interposed fibro-cartilaginous disks.

k. The prominence on the nasal bone on which the intermaxillary cartilage glides, and directed obliquely towards the eyeless side. Compare this with the corresponding part in the Turbot (fig. 1).

Fig. 9. Under surface of the same cranium. Lettering as in the corresponding view of the Turbot's cranium.

Fig. 10. Anterior part of another cranium, seen from above, though slightly tilted towards the eyeless (left) side; the two frontals removed. A bristle passed through each olfactory foramen.

g h. The two notches in the primordial cartilage, already referred to under fig. 8. The remaining lettering is the same as in the figures of the Turbot's cranium.

Fig. 11. The two frontal bones of the Halibut. Lettering as in figure 7.

Fig. 12. Cranium of the Plaice (*Platessa vulgaris*), seen from above. Lettering as in the figure of the Halibut's cranium (fig. 8). The prefrontal bone and olfactory foramen of the eyed side (right) are much in advance of the corresponding parts on the eyeless (left side); and the ridge (*k*) on which the intermaxillary cartilage glides is directed to the eyeless side at an angle of 45°.

Fig. 13. Under surface of same cranium. Lettering as before.

Fig. 14. Frontal bones of the Plaice, the position of the eyes in relation to them being indicated in dotted outline. Lettering as in fig. 7.

Fig. 15. Frontal bones of the Pole (*Platessa pola*), showing a condition, of the interocular process of the bone of the eyeless side, intermediate between that in the Halibut (fig. 11) and in the Plaice (fig. 14).

Fig. 16. Cranium of the Cod (*Gadus morrhua*), seen from the left side.

Nasal part of the cranium: c, olfactory foramen.

Orbital portion, the interorbital fibrous septum being indicated in dotted shading.

The brain-cavity and auditory part of the cranium.

Fig. 17. Left prefrontal of the Cod, disarticulated.

a. Process going upwards and backwards to join the frontal.

b. Process going downwards and backwards to join the basi-presphenoid.

c. Process to join the ala of the vomer.

d d. Two processes going towards the nasal bone, with an olfactory notch (c) between them.

e. Process to which is attached the anterior suborbital bone.

The representatives of these processes in the prefrontal bones of the flatfish are marked with the same letters in the preceding figures. Note, that in the Cod there is no representative of the process *f* in the flatfish.

PLATE XXX.

Fig. 1. Suspensory, palatine, and opercular bones of the ocular side in the Turbot. Cartilage shaded with horizontal lines.

Fig. 2. The same bones, but of the eyeless side.

Fig. 3. Front view of the cranium and palato-suspensory apparatus of the Halibut, to show the greater flatness of the latter bones on the eyeless side, the greater elevation on the same side of the olfactory foramen (c), the articulation of the palate-bone to the prefrontal, and of the articulation of the lower jaw to the trochlea (*) on the hypotympanic.

Fig. 4. Suspensory, palatine, opercular apparatus, and jaws of the eyed side of the Plaice, drawn from dried specimens.

Fig. 5. The corresponding bones on the eyeless side.

Fig. 6. Lower jaw and opercular apparatus of Plaice, seen from below.

Fig. 7. Cranium and palato-suspensory apparatus of Plaice, seen directly from the front. Lettering as in fig. 3.

PLATE XXXI.

Fig. 1. Opercular and oral apparatus of the Halibut, together with the "superficial face-bones," as seen on the ocular side.

a a. Tubular scales of the lateral line.

72. Supratemporal chain.

73′. Suborbital chain of the right or lower eye.

73 *a*. Anterior right suborbital, very much larger than the rest, from which it is separated by an interval. It has no connexion with the mucus-canal.

19′. Right "turbinal" ossicle, or *os terminale*.

19. Left turbinal, situated on the top of the snout.

A. Retractor maxillæ muscle.

B. Masseter.

c′. Right olfactory foramen.

e. Point at which the supratemporal mucus-canal sends down a branch to join the cross commissure.

Fig. 2. The same head as seen on the left or eyeless side.

a a. Tubular scales of lateral line.

72. Left supratemporal range of ossicles.

73′. Left suborbital range, thus situated on the other side of the head from its eye, and having the dorsal fin and both supratemporal ranges interpolated between.

19. Left turbinal, or *os terminale.*

Fig. 3. Sketch of the distribution of the mucus-canals on the right or ocular side of *Platessa vulgaris*, the Plaice.

a a a a. The main canal, extending from the tail along the lateral line and along the head, between the eyes, till it ends on the inner or left side of the nostril, giving off on its way many little ducts, which open on the surface of the skin of the supratemporal branch, *b b*, which branch, though usually simple, is here bifurcated.

c c c. Operculo-mandibular branch.

d d. Right suborbital canal.

e indicates the cross commissure given off to join the mucus-canal system of the opposite side. It gives off a little duct to the skin at the posterior margin of the orbit, and then passes to the left side, beneath the cephalic end of the dorsal fin.

Fig. 4. The same head, seen from the eyeless side.

a a a a. The main canal as before, but stopping short at the cross commissure (*e*).

b. Supratemporal canal, not so long as in the right side.

c c c. Operculo-mandibular canal.

d d d. Left suborbital canal, still remaining on this side, while its eye has been transferred to the right side.

a′. A small follicle or detached portion of mucus-canal, the representative of the nasal extremity of the main canal of this side, the portion intervening between it and the cross commissure having disappeared. (See also Plate XXXII. fig. 3, where this arrangement is represented diagrammatically.)

e. Cross commissure.

E. Upper eye, a small portion of which is, in the Plaice, visible from the left side.

Fig. 5. Sketch of the distribution of the mucus-canals on the right or ocular side of the head of *Platessa pola.* The same letters refer to the same canals as in the head of the Plaice, fig. 3. The commissural (*e*), however, ends blindly: thus there is in this fish no connexion between the canal-systems of the two sides.

Fig. 6. The left side of the head of the same fish, the mucus-canals being here seen to be dilated into large ampullæ, which communicate with each other by small openings. Each ampulla generally sends only one little duct to the external surface of the skin.

a a a a a a. The lateral canal and the series of six ampullæ on the main canal of the head.

a′. The part detached from the rest, and lodged in the left turbinal. It is the homologue of the little follicle marked *a′* in the Plaice, fig. 4.

b b b b. The four ampullæ into which the supratemporal canal is dilated.

c c c c. The eight ampullæ of the operculo-mandibular branch.

d d d d. The six ampullæ of the suborbital branch.

Fig. 7. Skeleton of the left side of the head in *Platessa pola*, showing the bones supporting the ampullated mucus-canals.

50. Suprascapular.

72. The five supratemporal bones.

73′. The five suborbitals.

19. Turbinal ossicle, or *os terminale.*

34. Præoperculum ; and

Fig. 1.

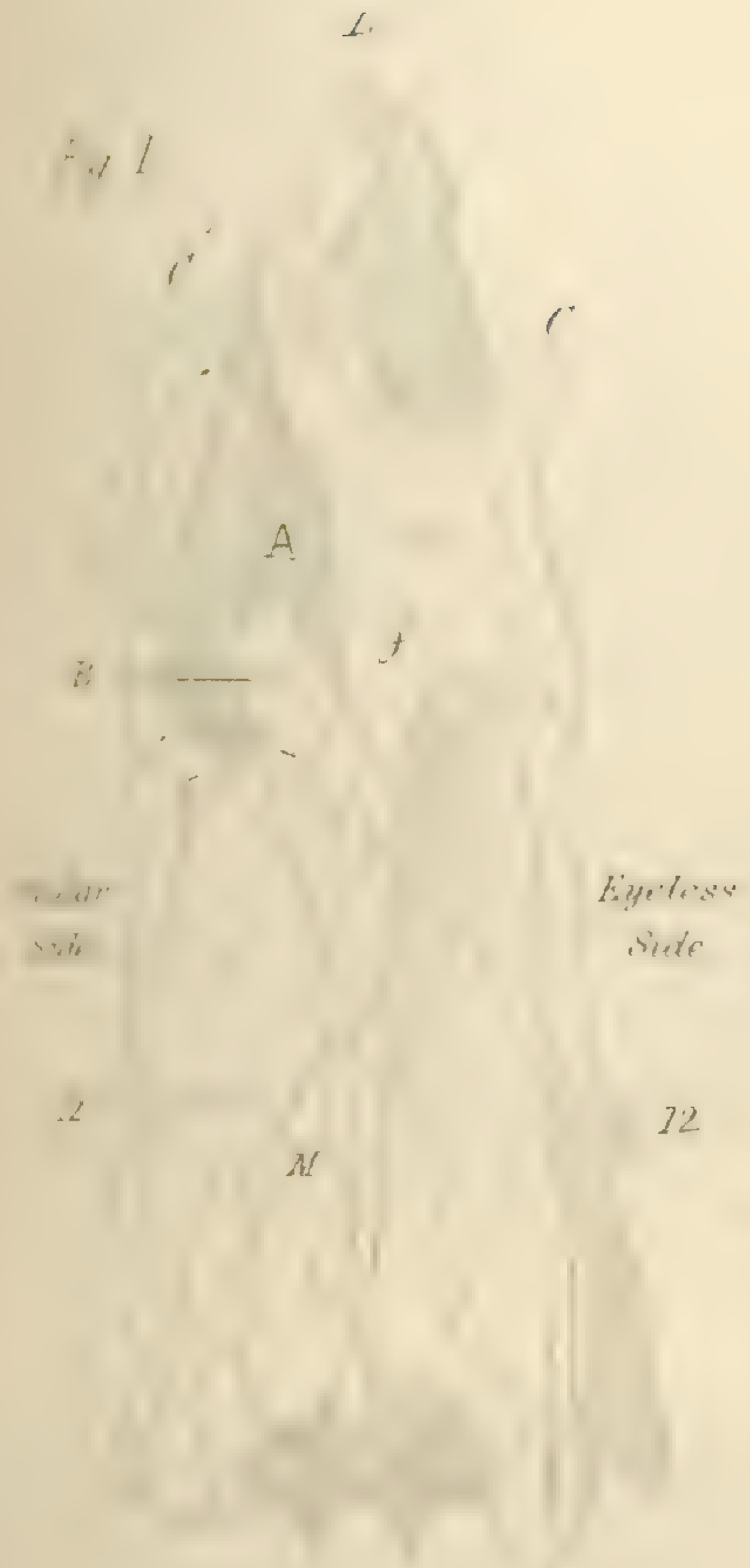

L
C
C
A
B
Ocular Side
Eyeless Side
12
12
M

Fig. 2.

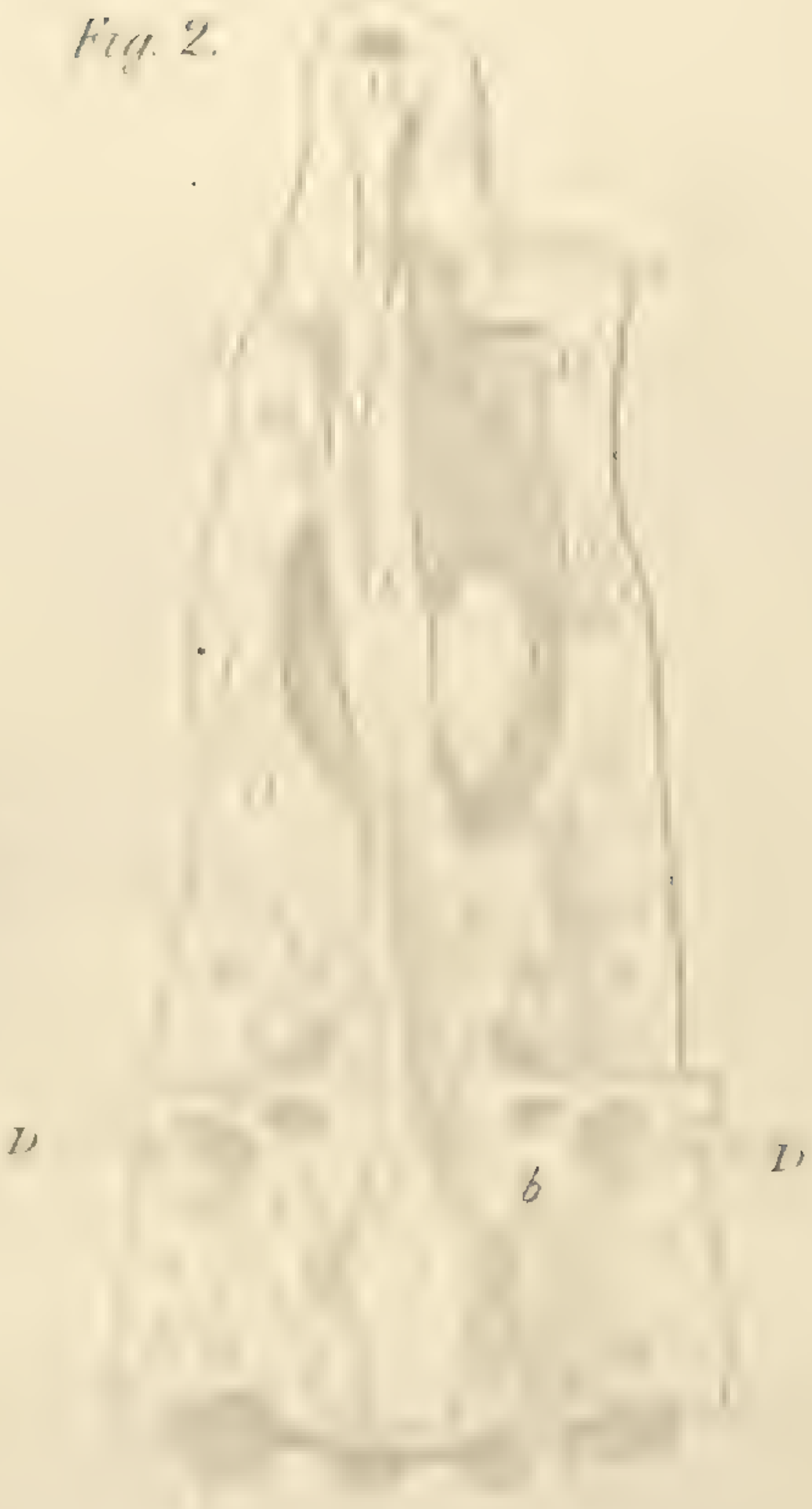


Fig. 3.

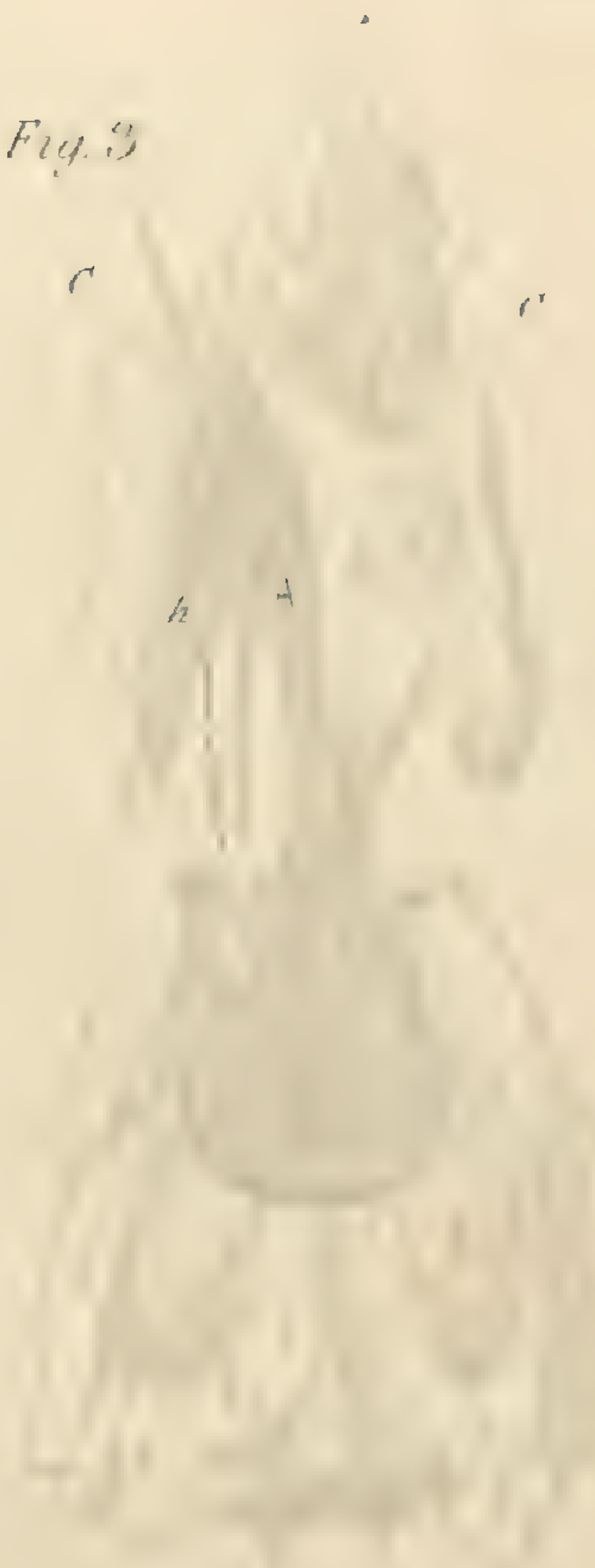


Fig. 8.

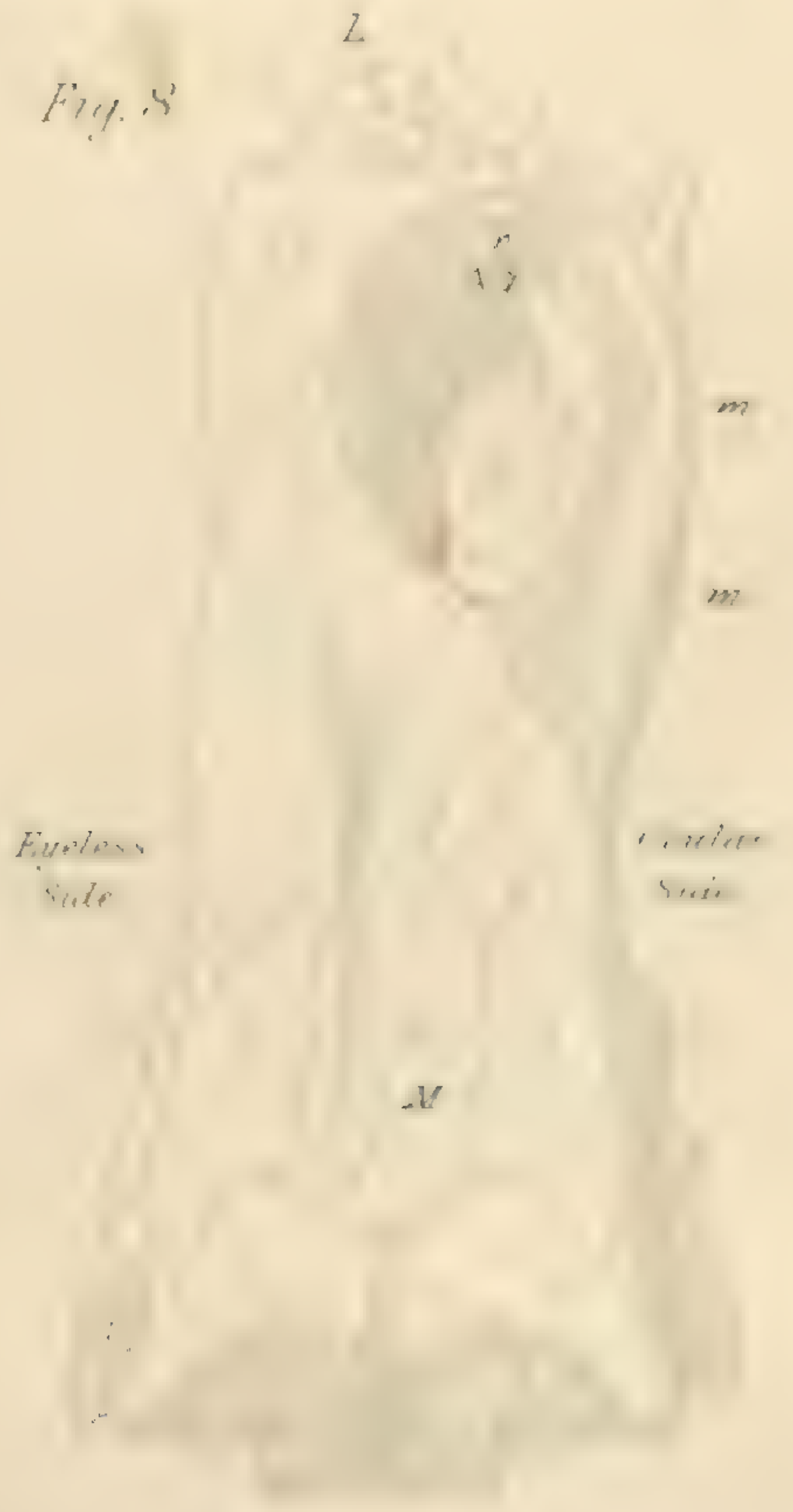

L
m
m
Eyeless Side
Ocular Side
M

Fig. 4.

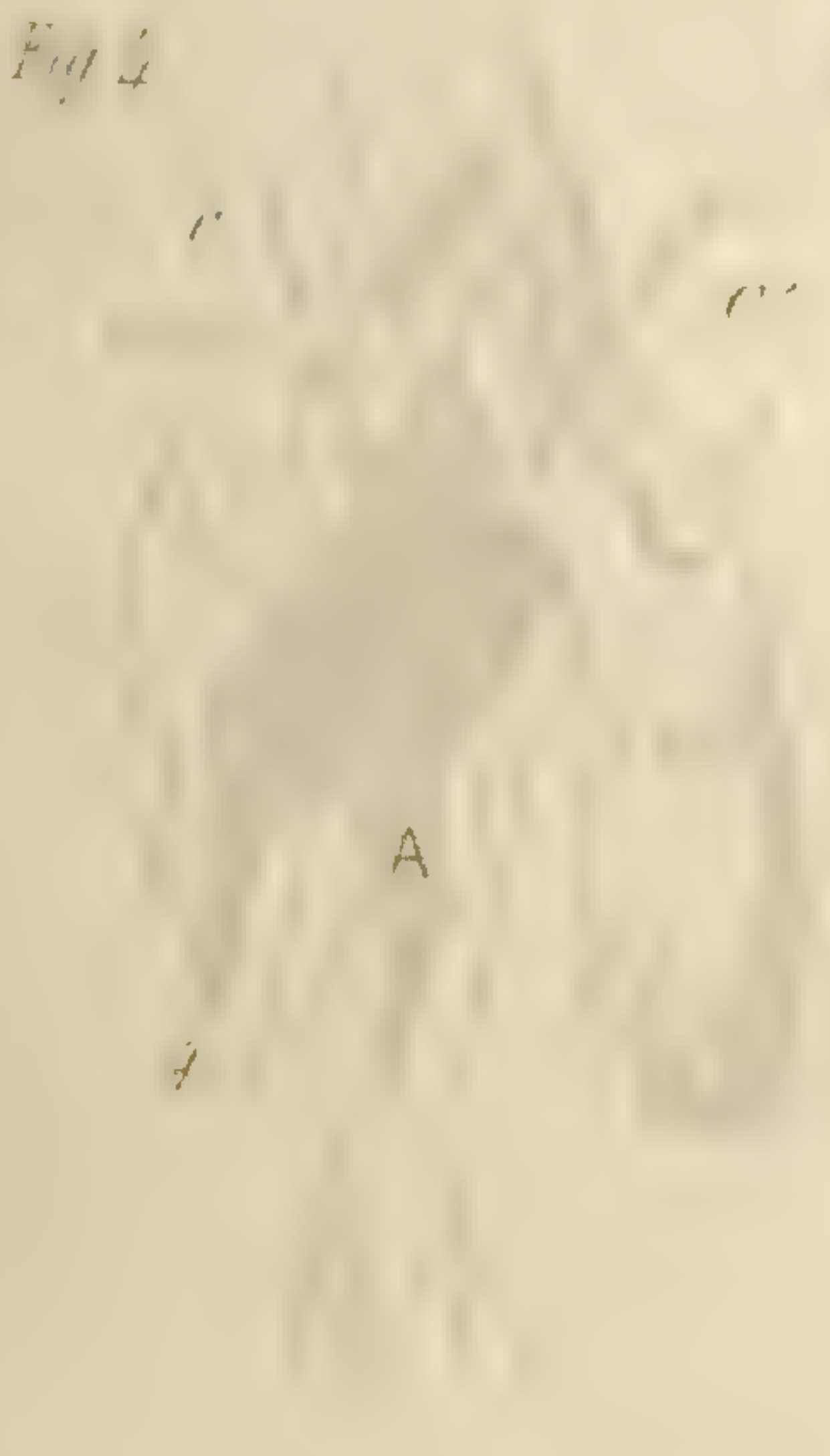


Fig. 5.

Fig. 15.

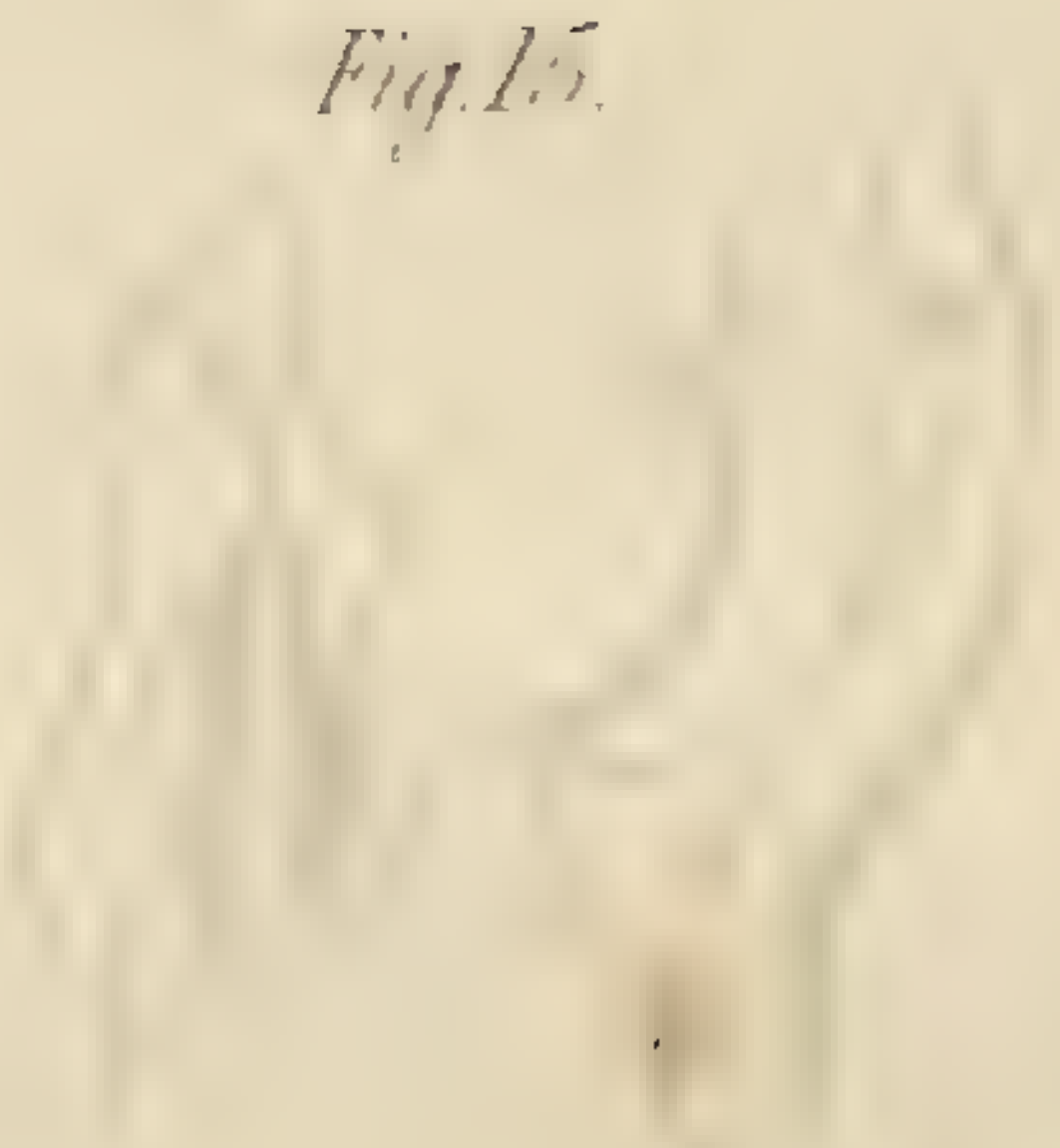


Fig. 10.

Fig. 9.

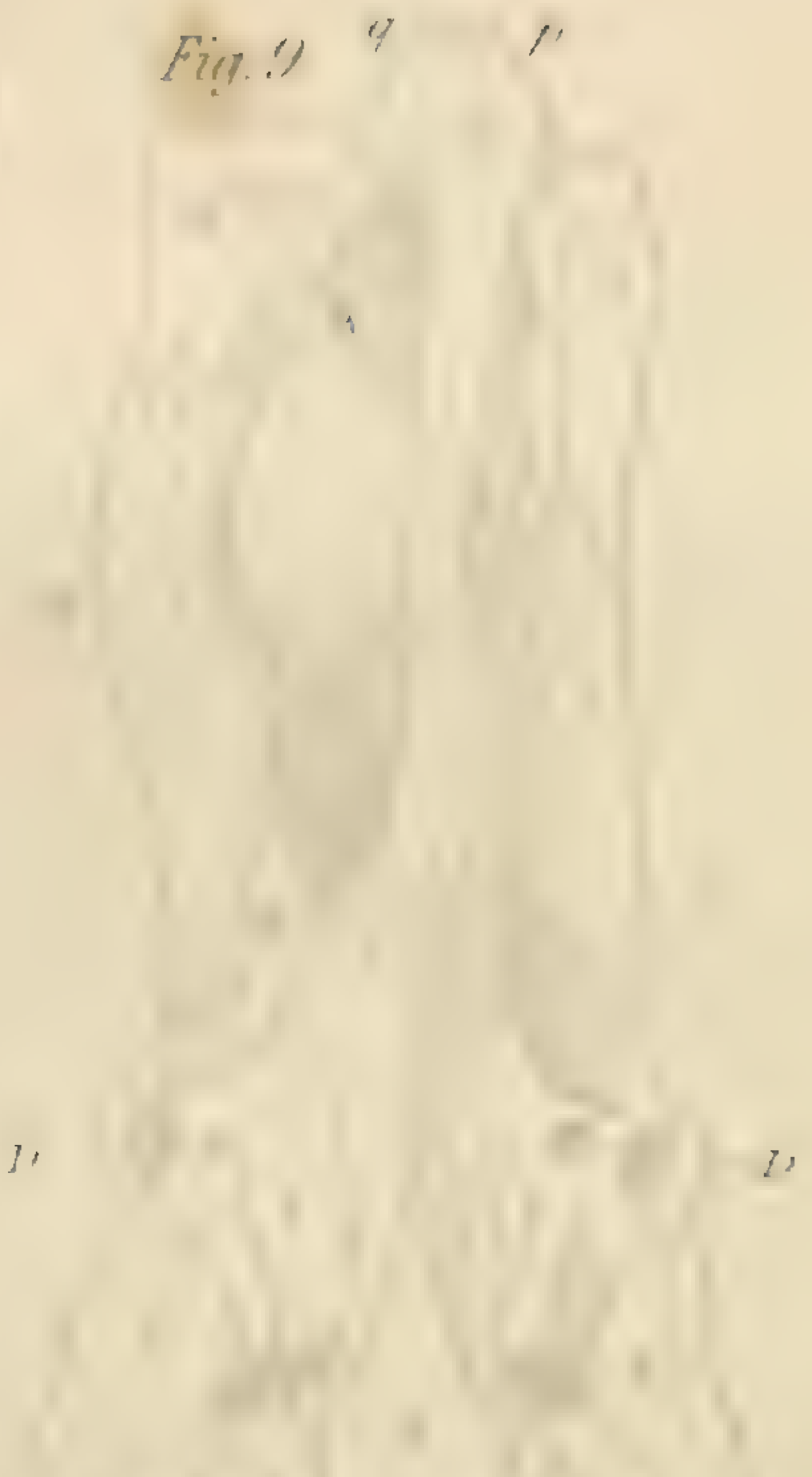


Fig. 11.

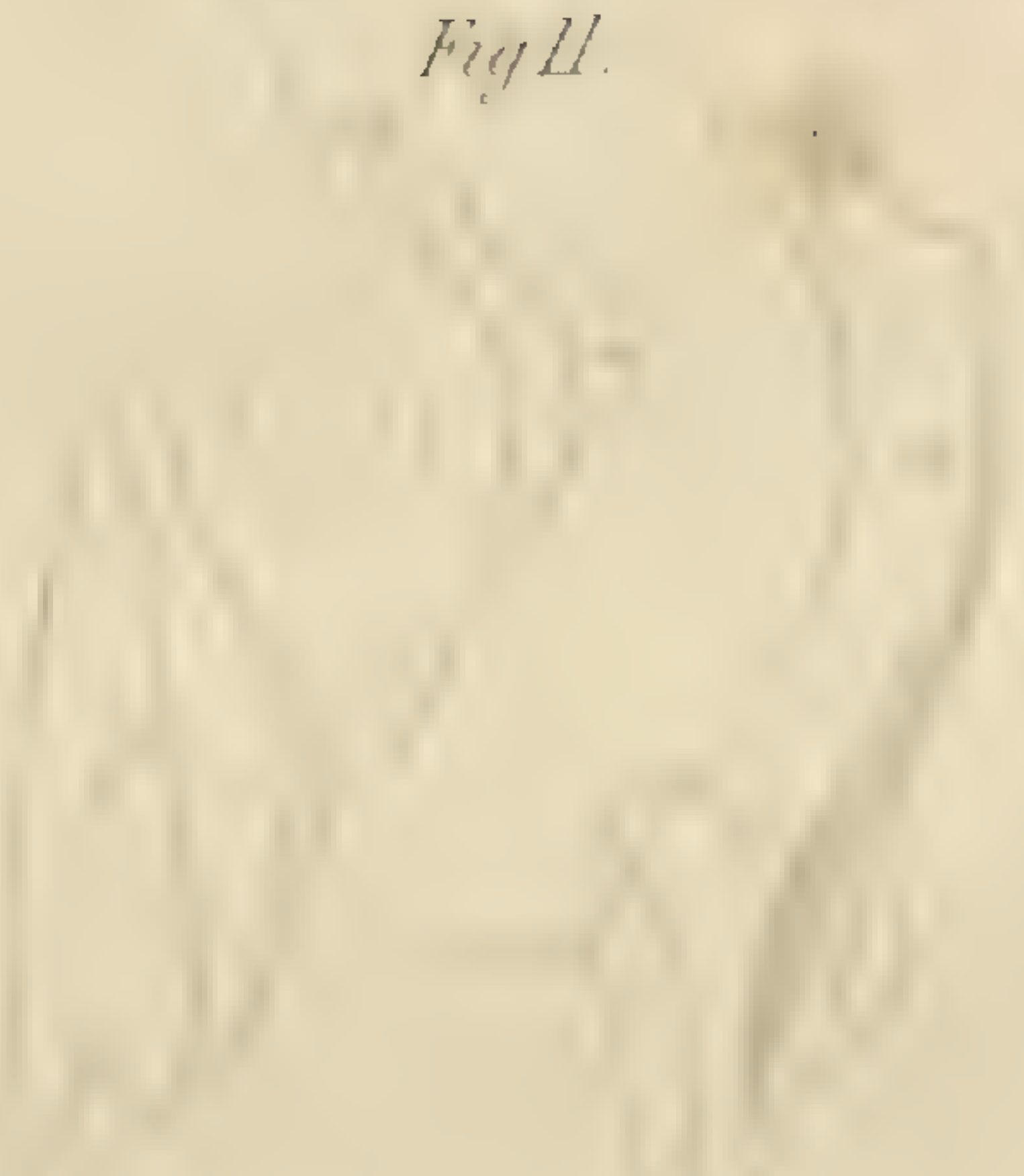
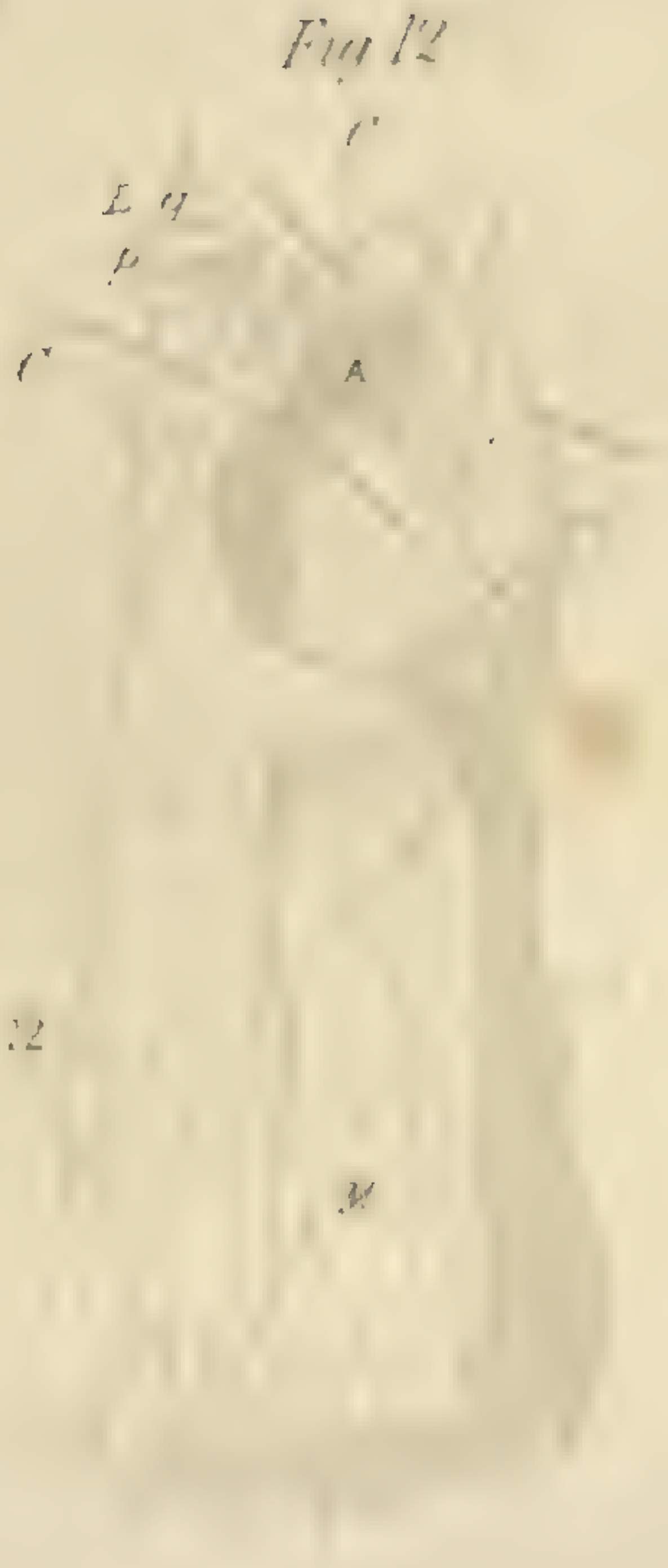


Fig. 6.

Fig. 7.

Fig. 14.

Fig. 12.



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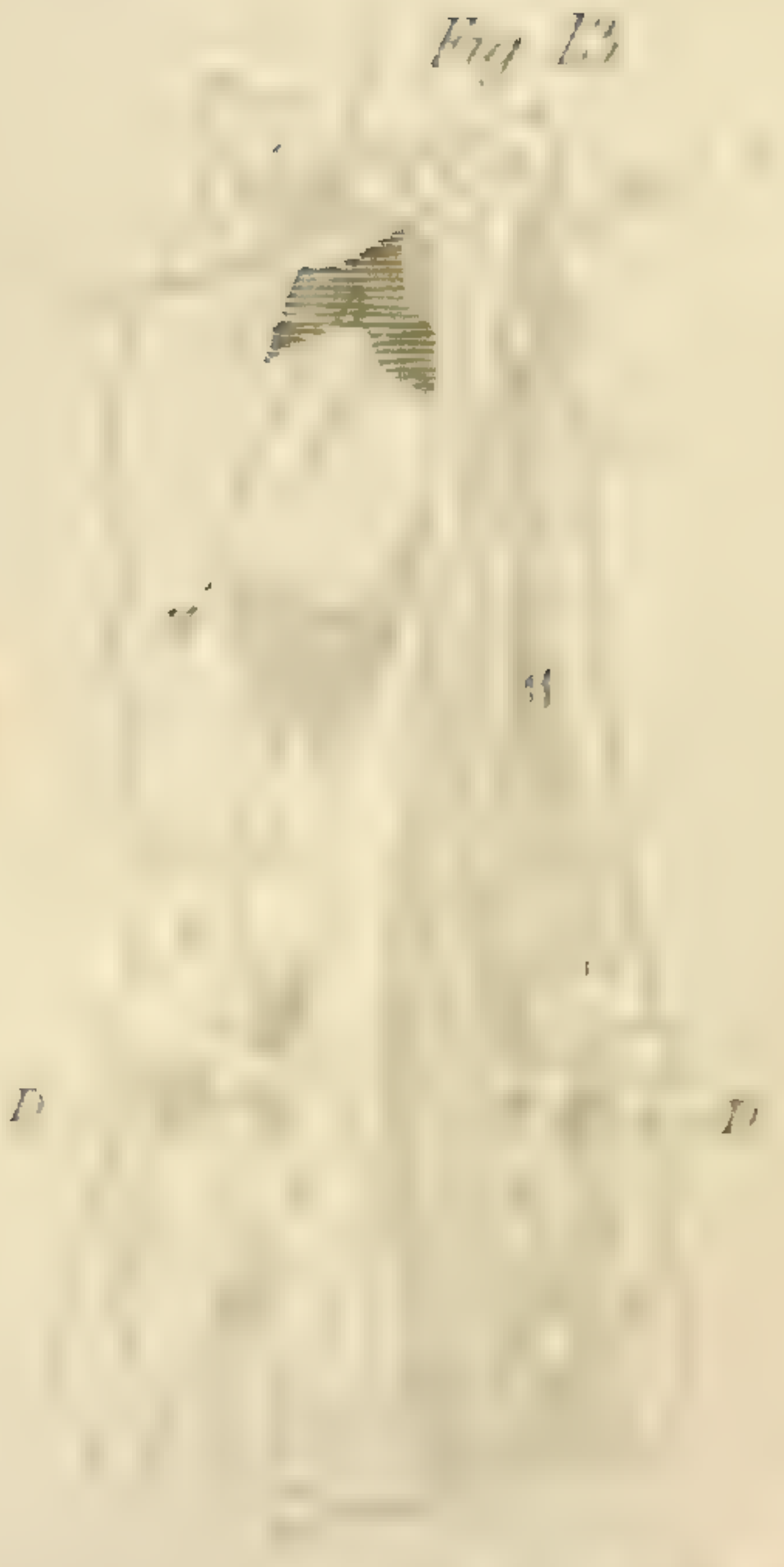

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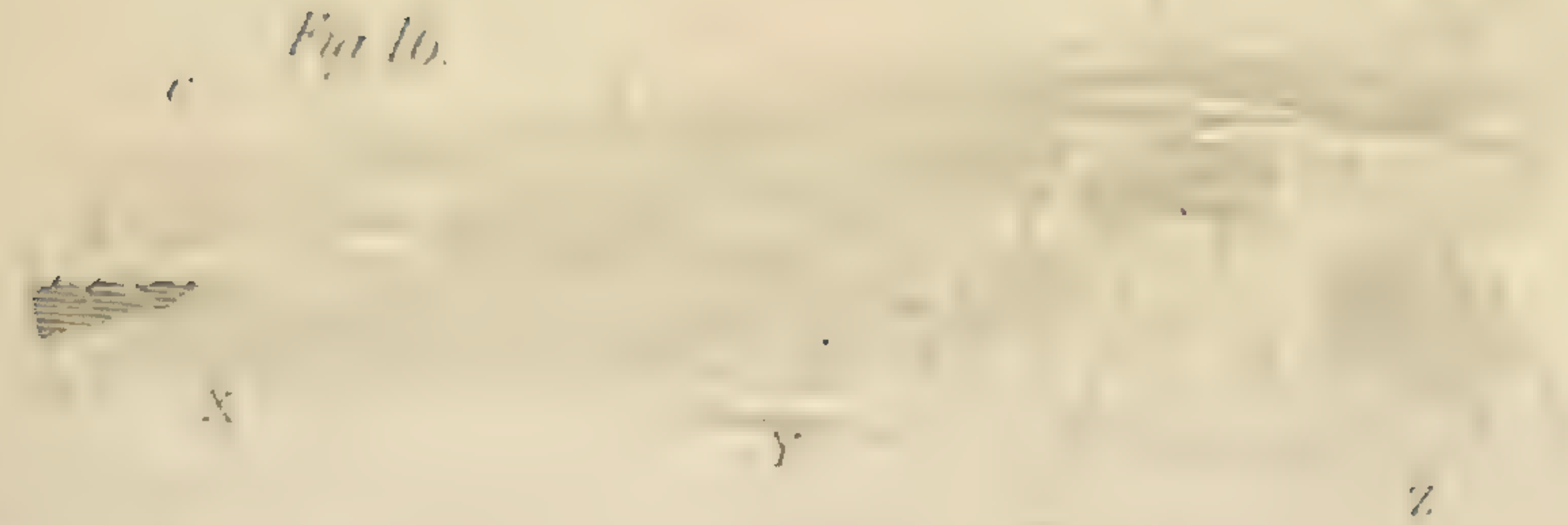

Fig. 17.

R. H. Traquair M.D. delt.

Edwin M. Williams F.L.S. sc.

Fig. 1

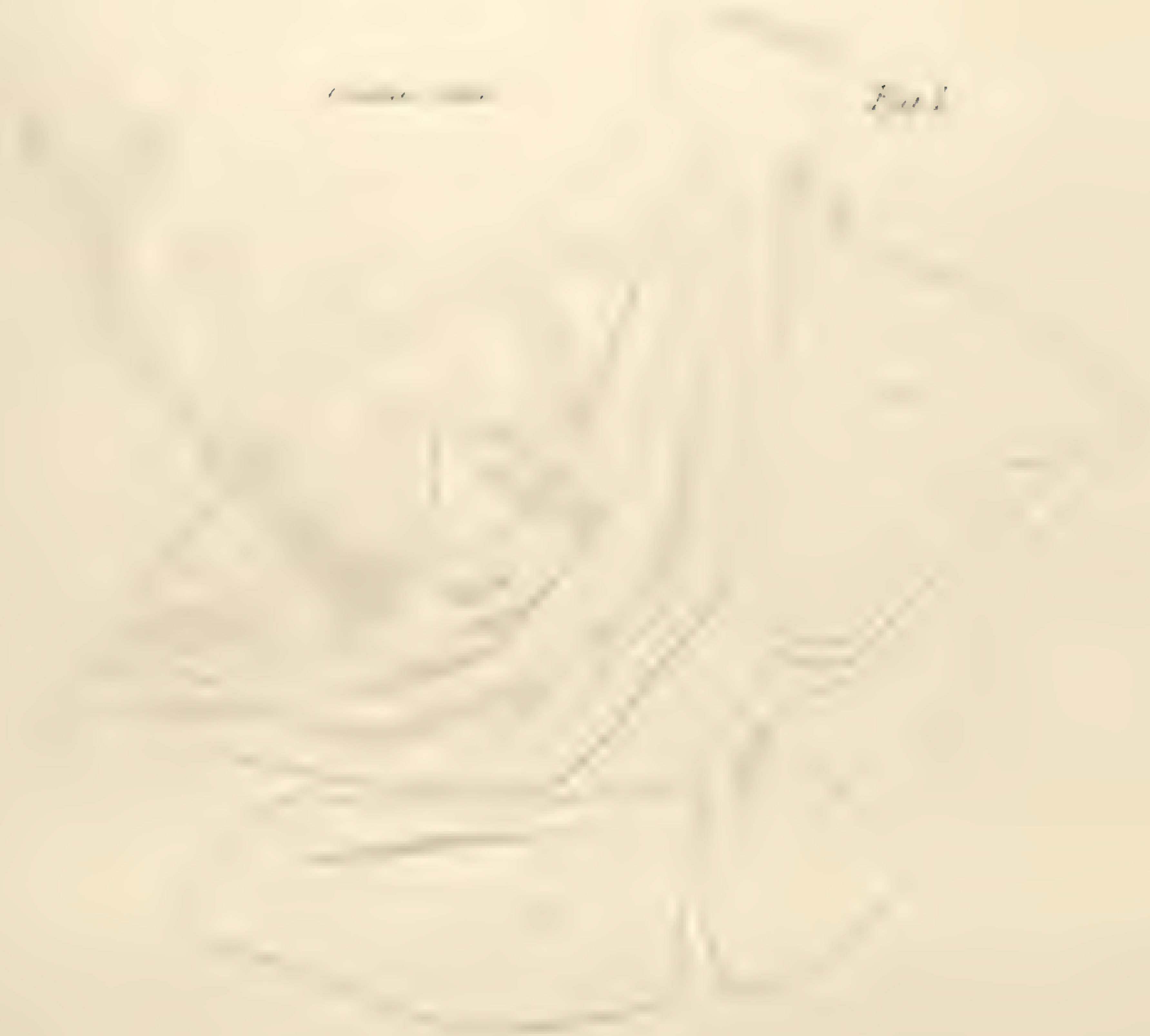
Ocular Side

Fig. 3

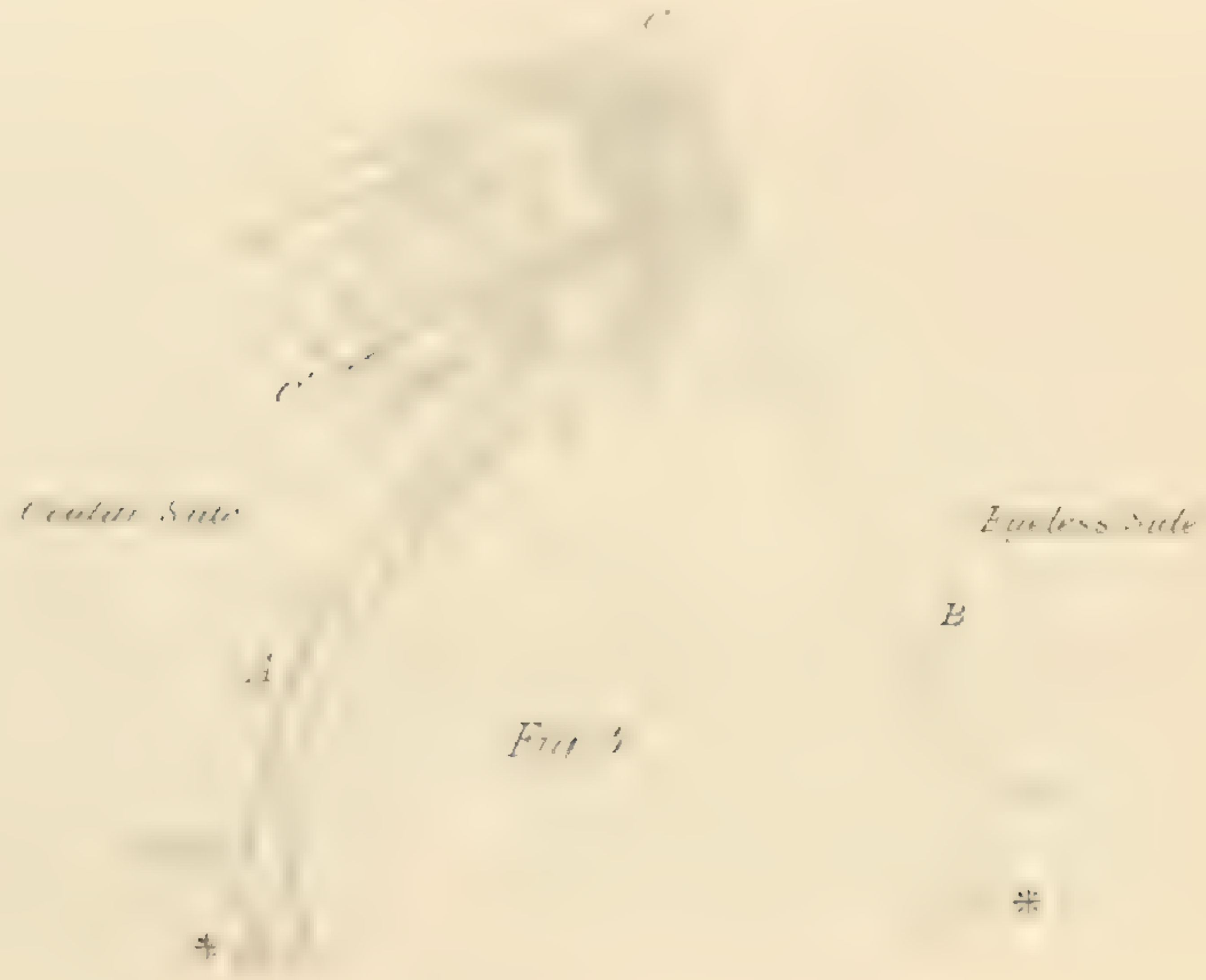
C
C'
Ocular Side
Eyeless Side
A
B
*
*

Fig. 2

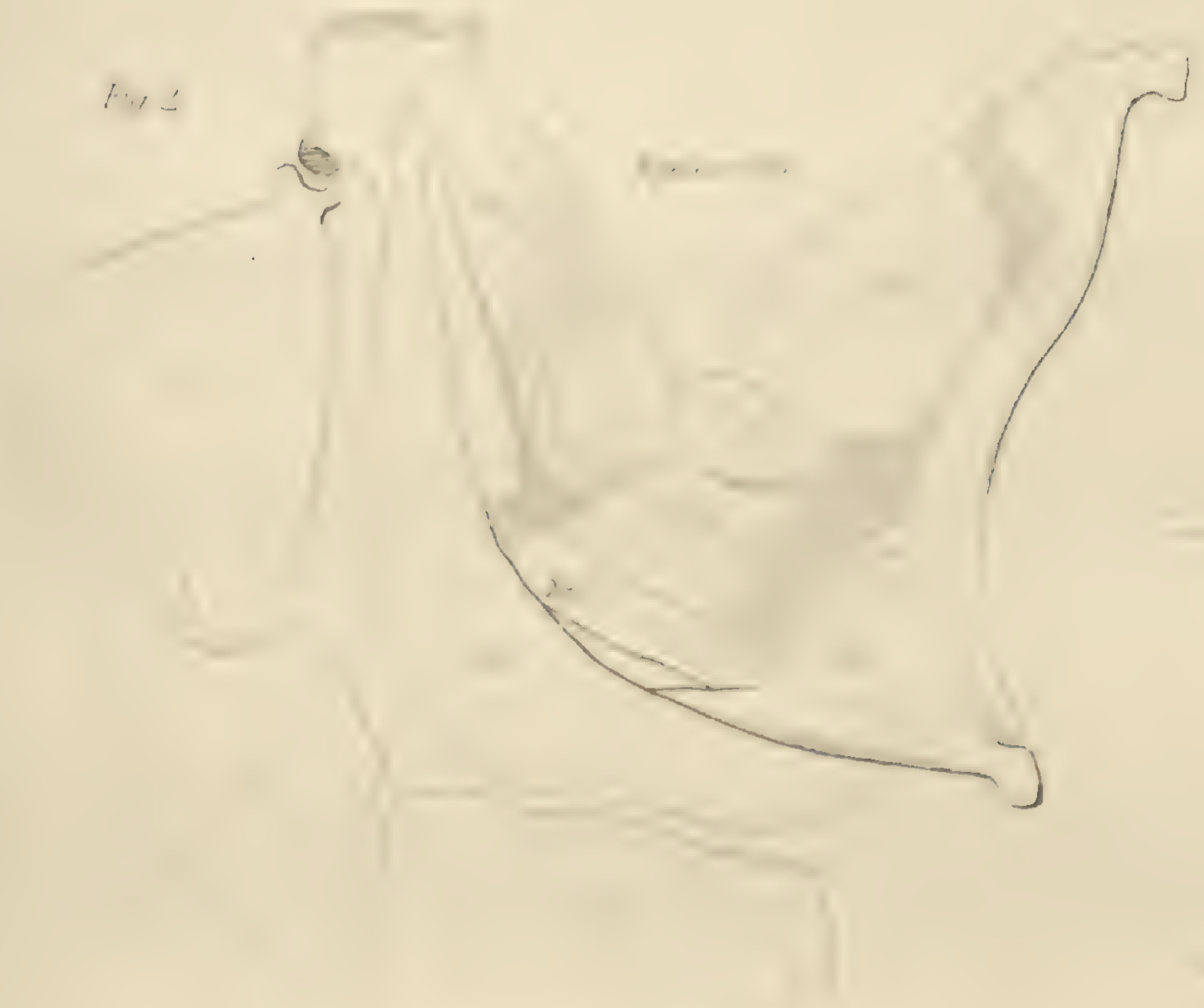
Eyeless Side

Fig. 7

C
C'
Ocular Side
Eyeless Side
*
*

Fig. 6

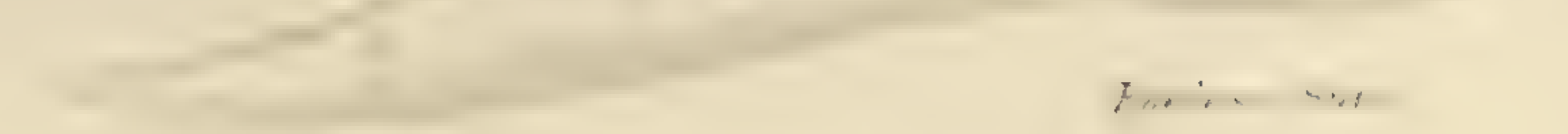
Ocular Side
Eyeless Side

Fig. 4

Ocular Side

Fig. 5

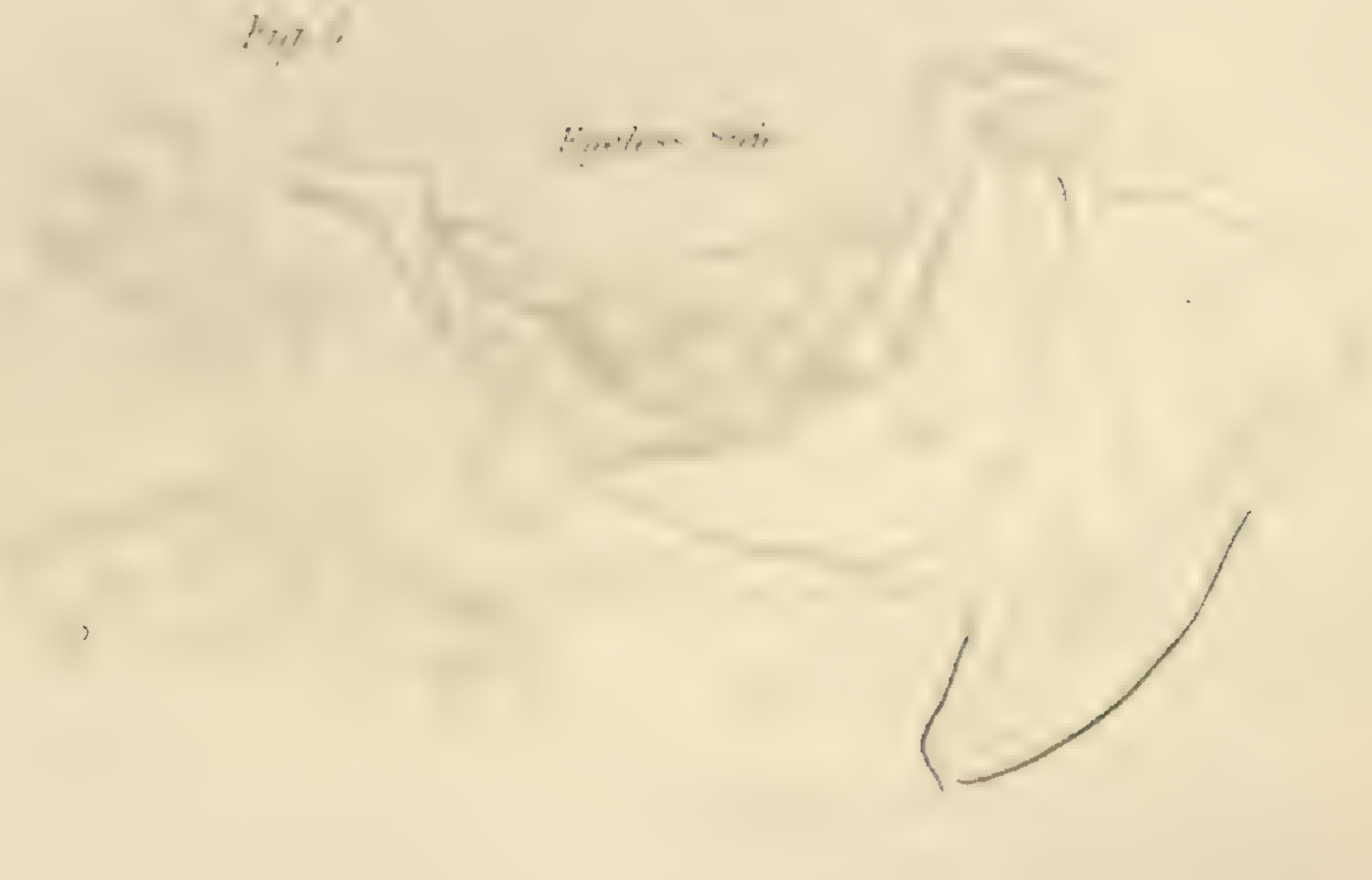
Eyeless Side

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Fig 1

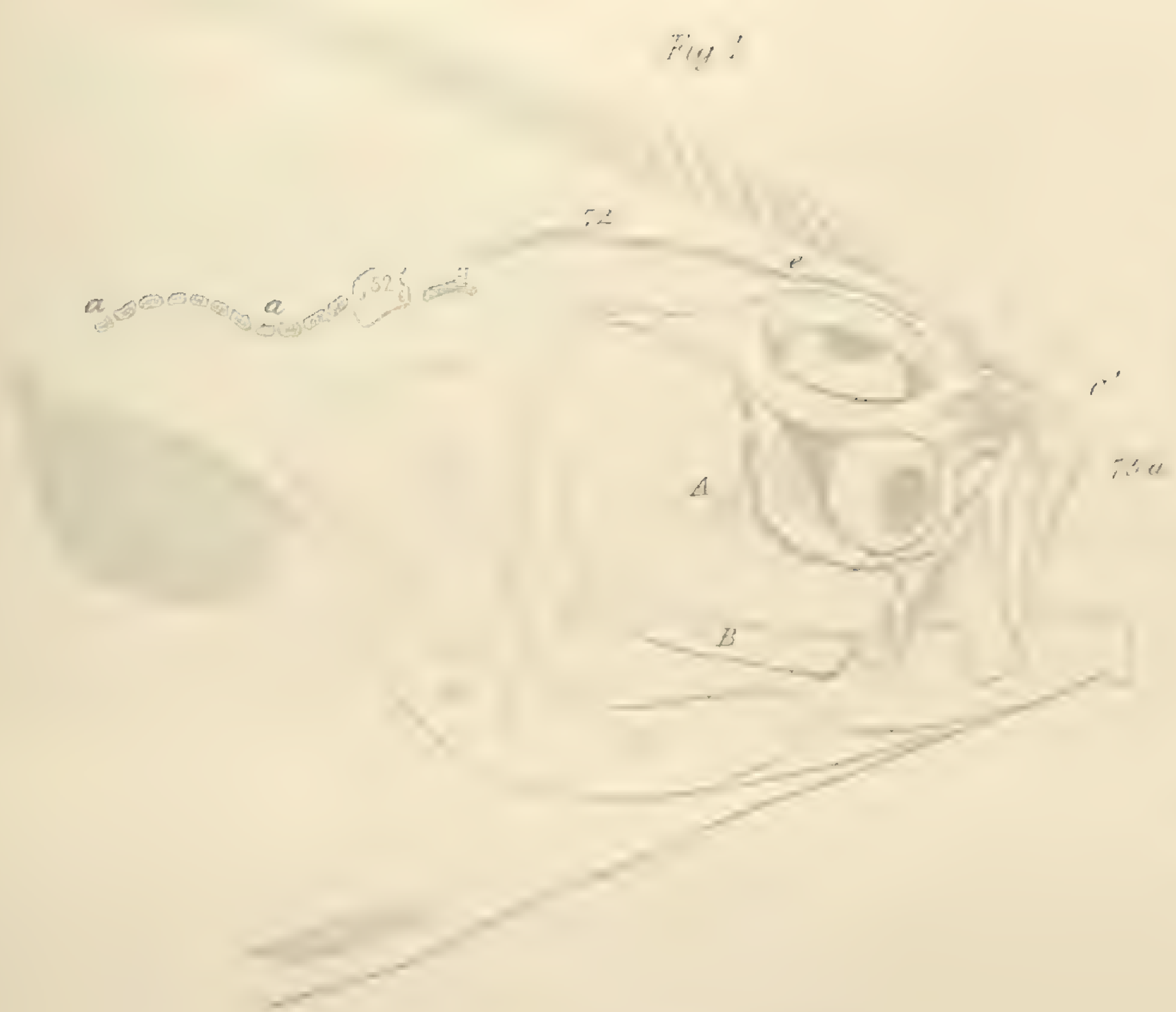

72
a
a
32
e
c'
73 a
A
B

Fig 3

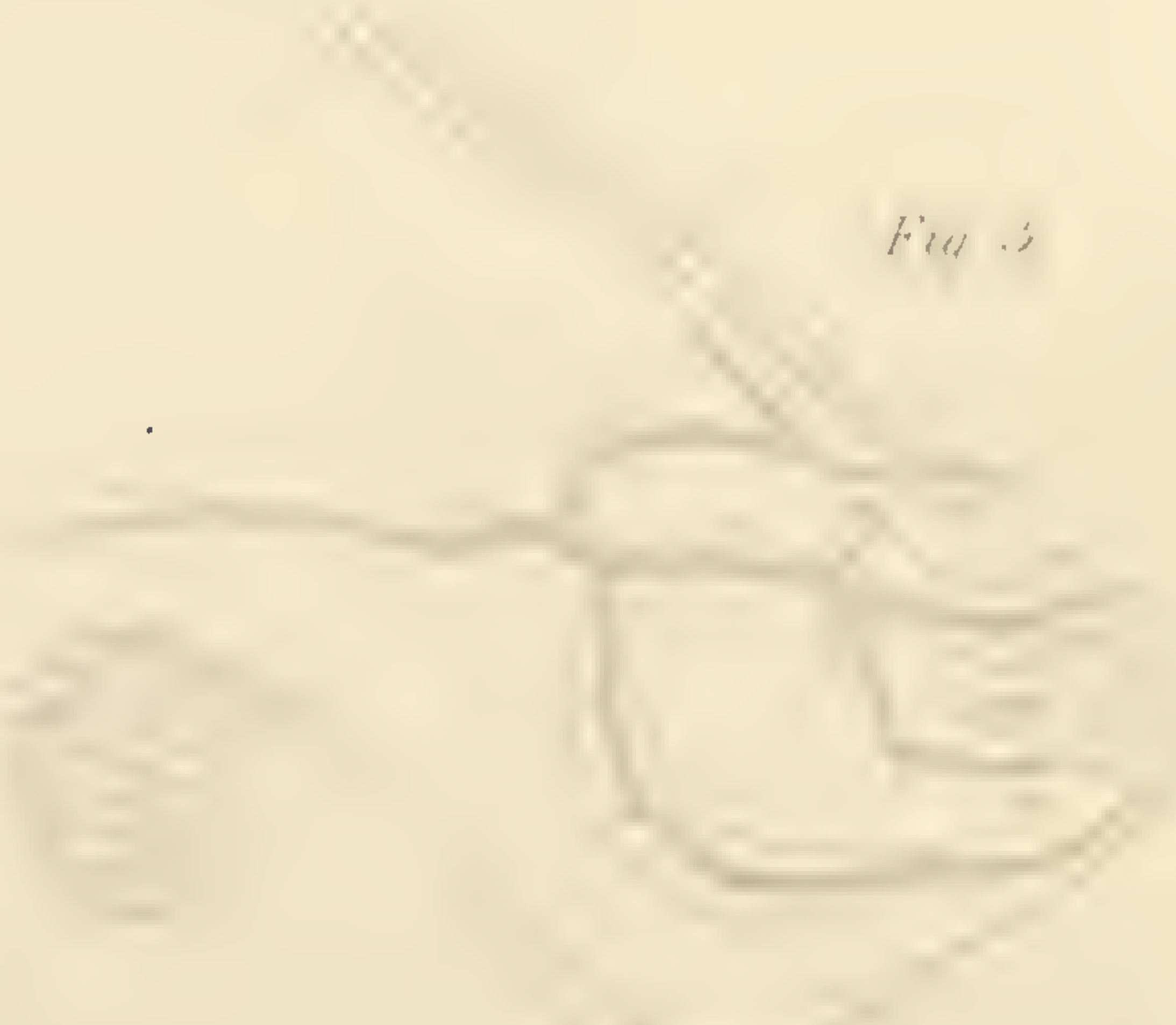


Fig 4

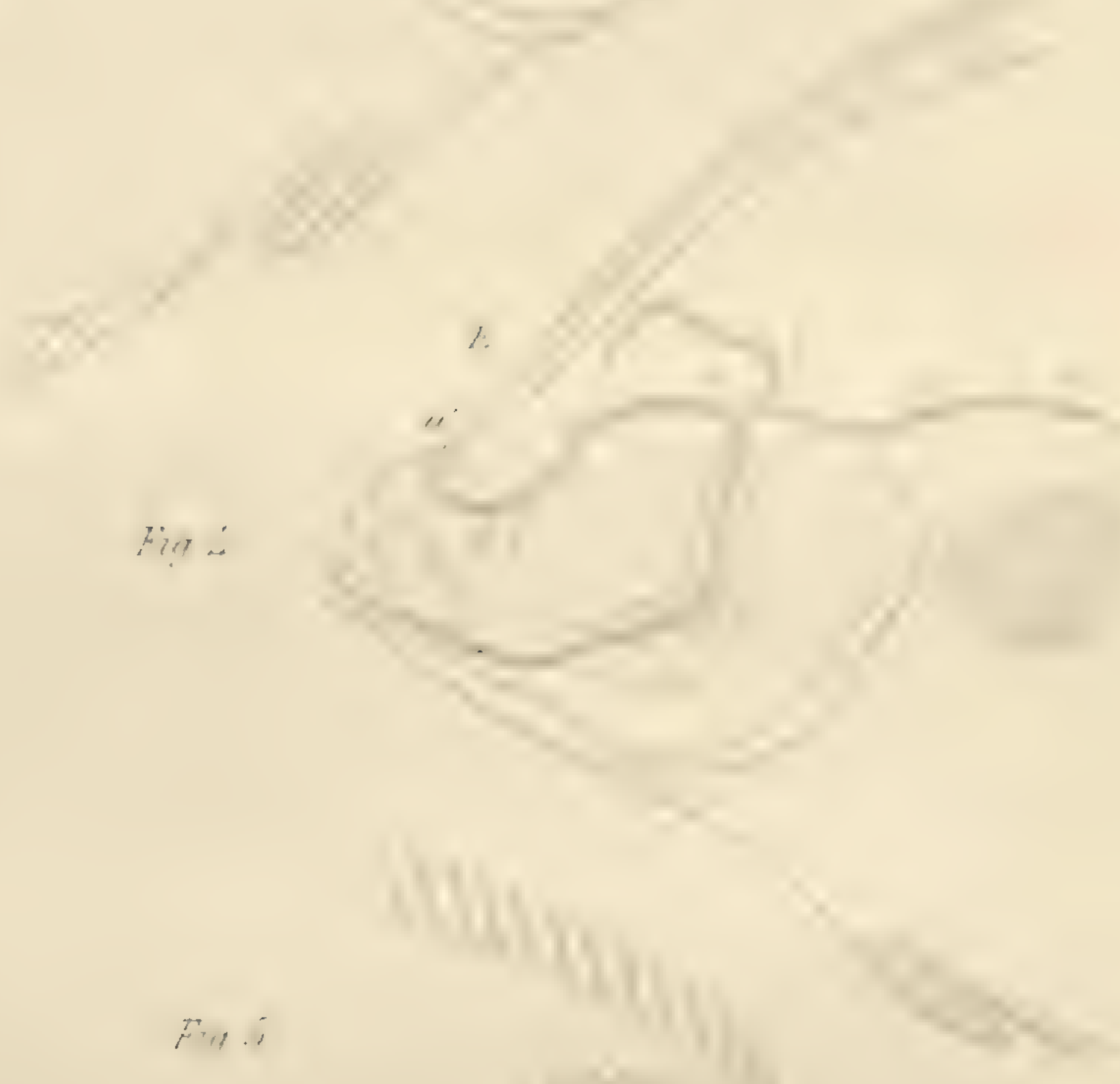


Fig 2

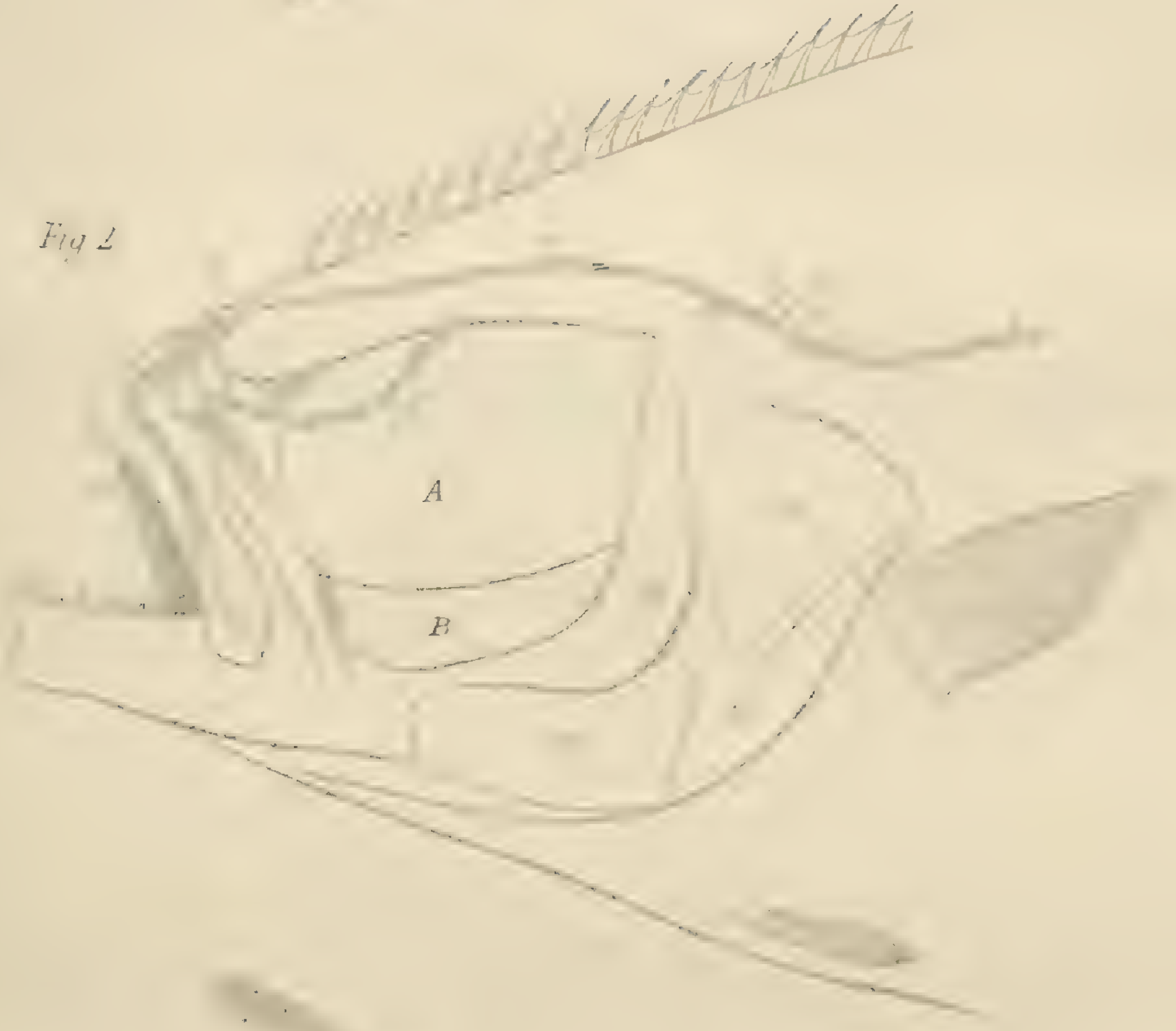


Fig 5

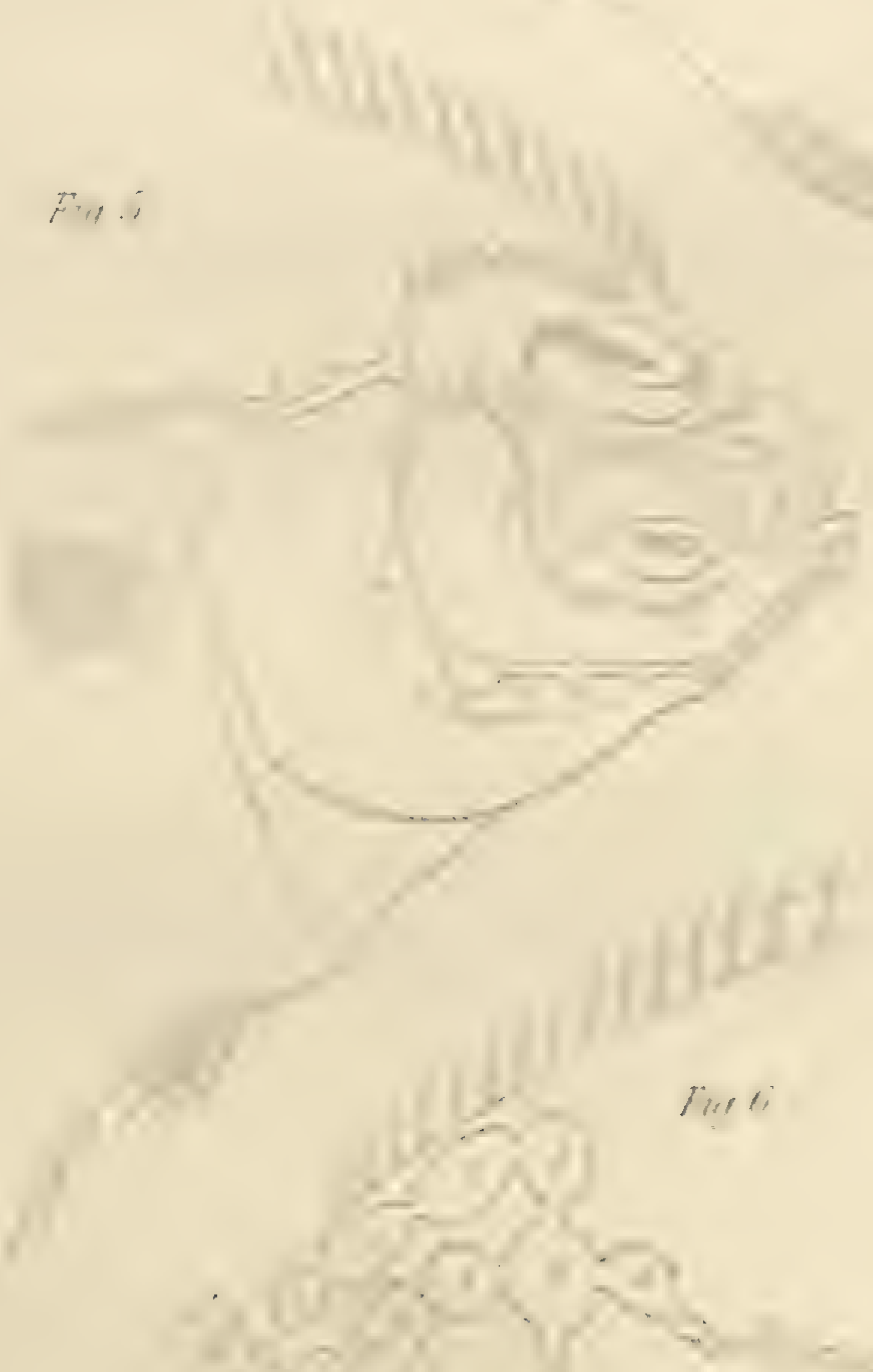


Fig 8

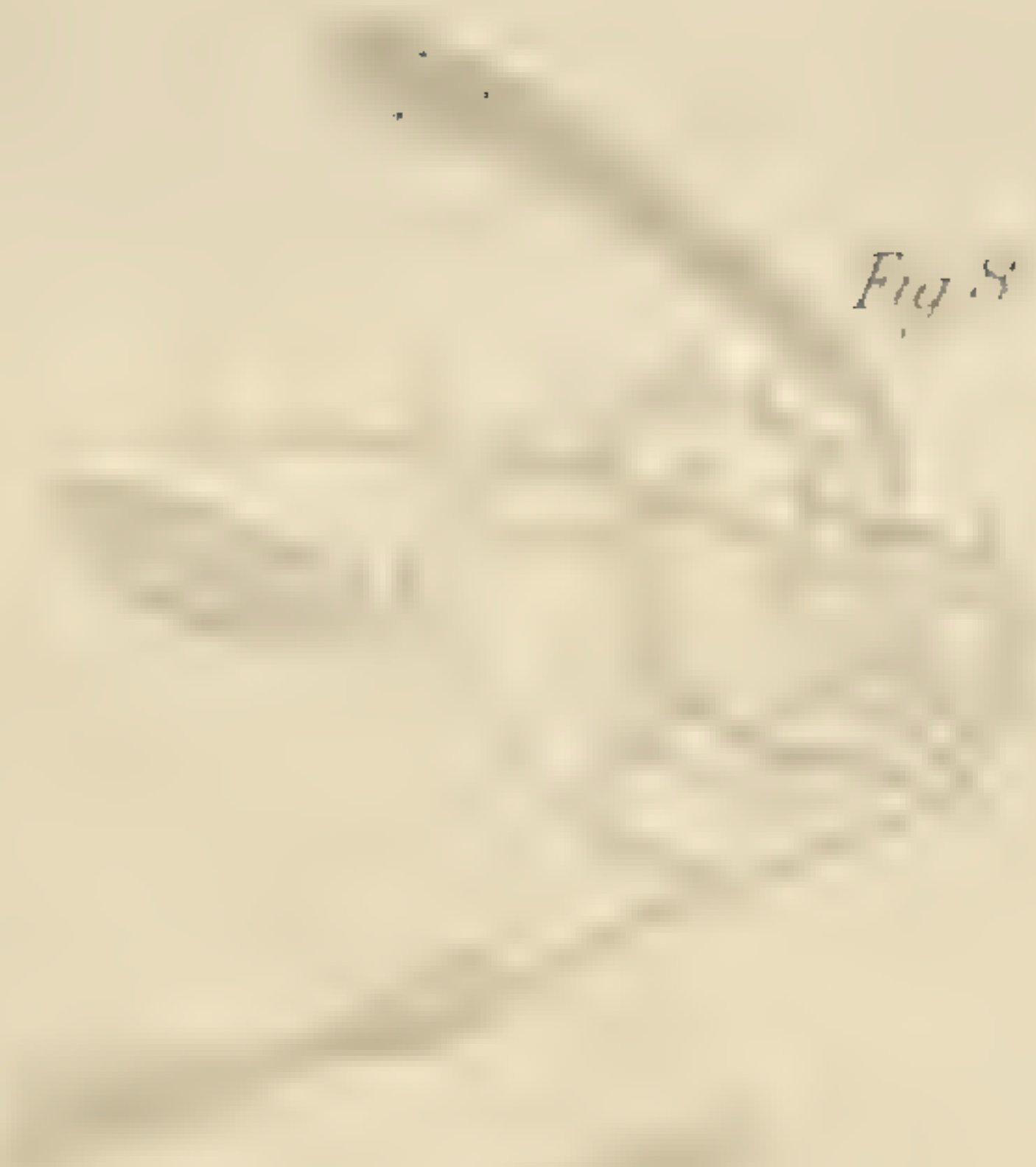


Fig 7

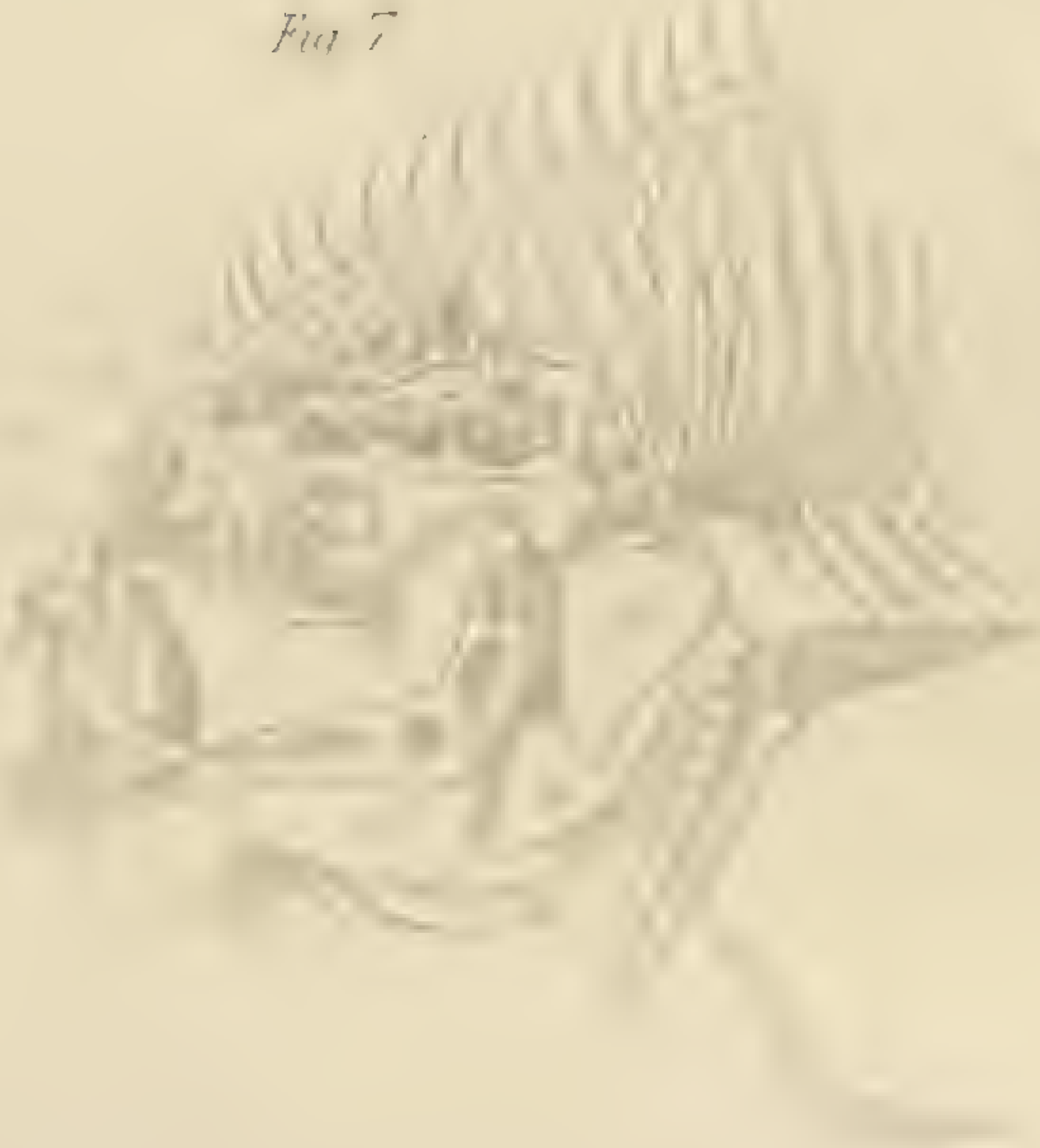


Fig 6

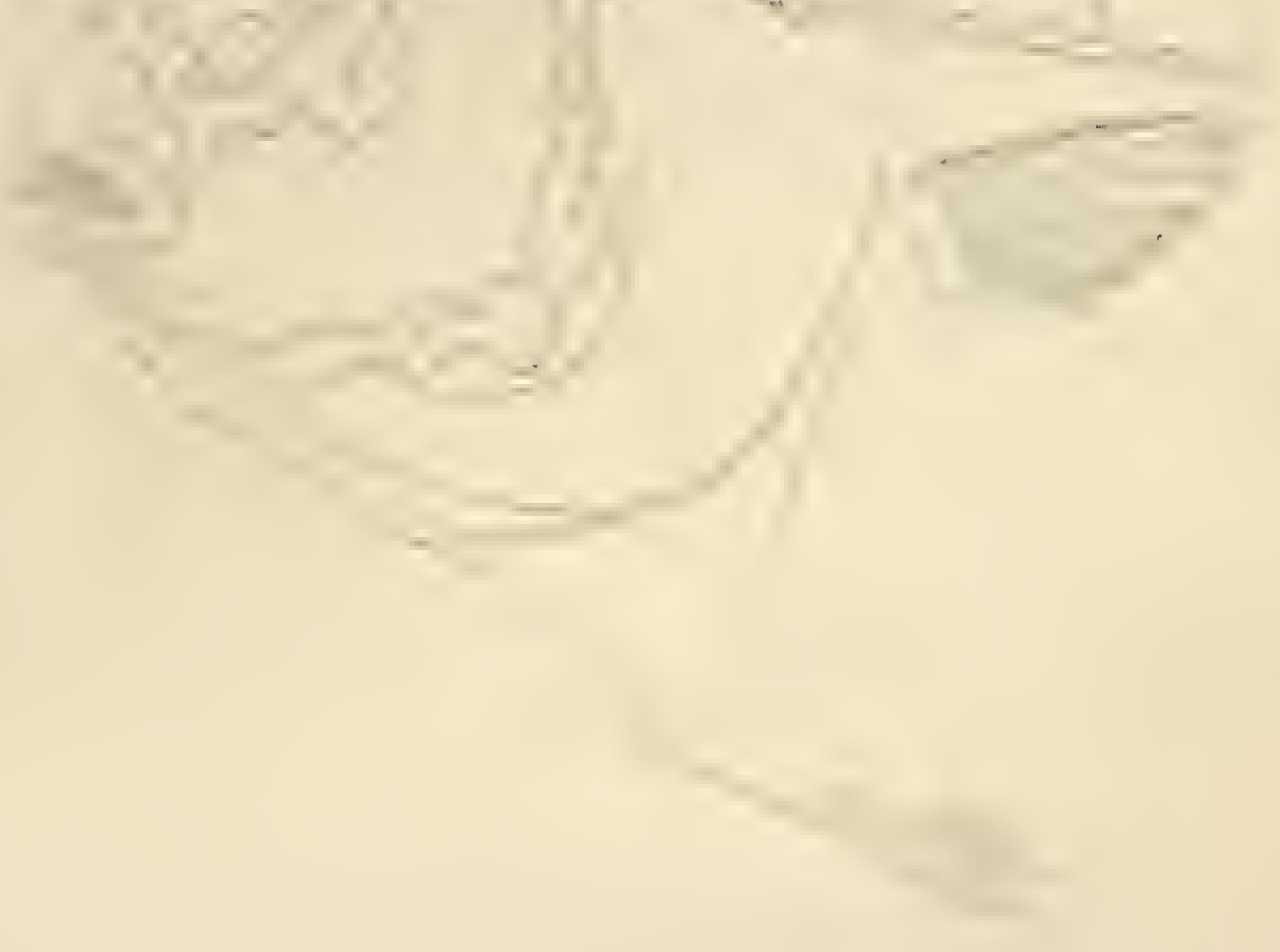
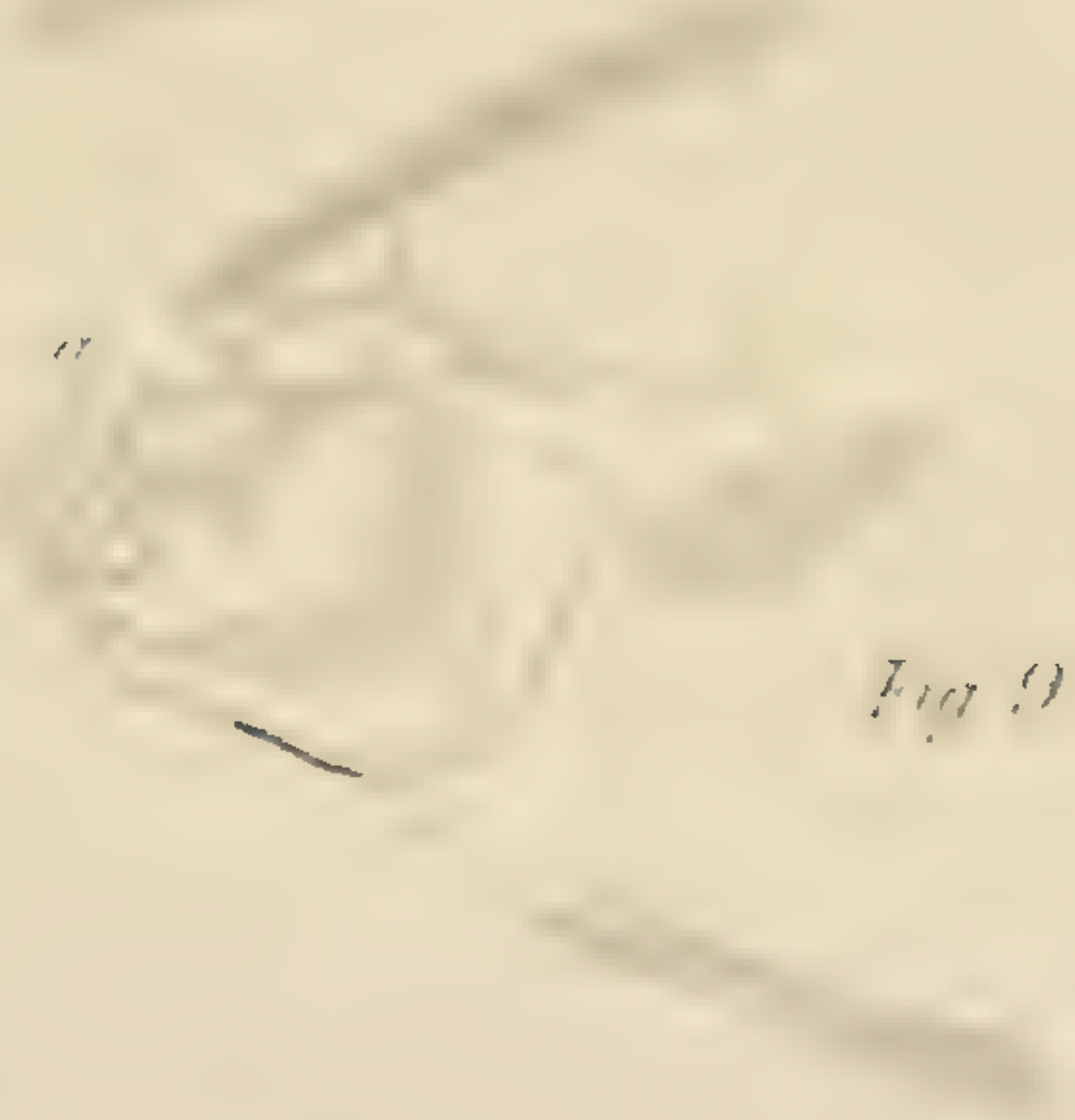


Fig 9



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Edwin [illegible]

Fig. 1

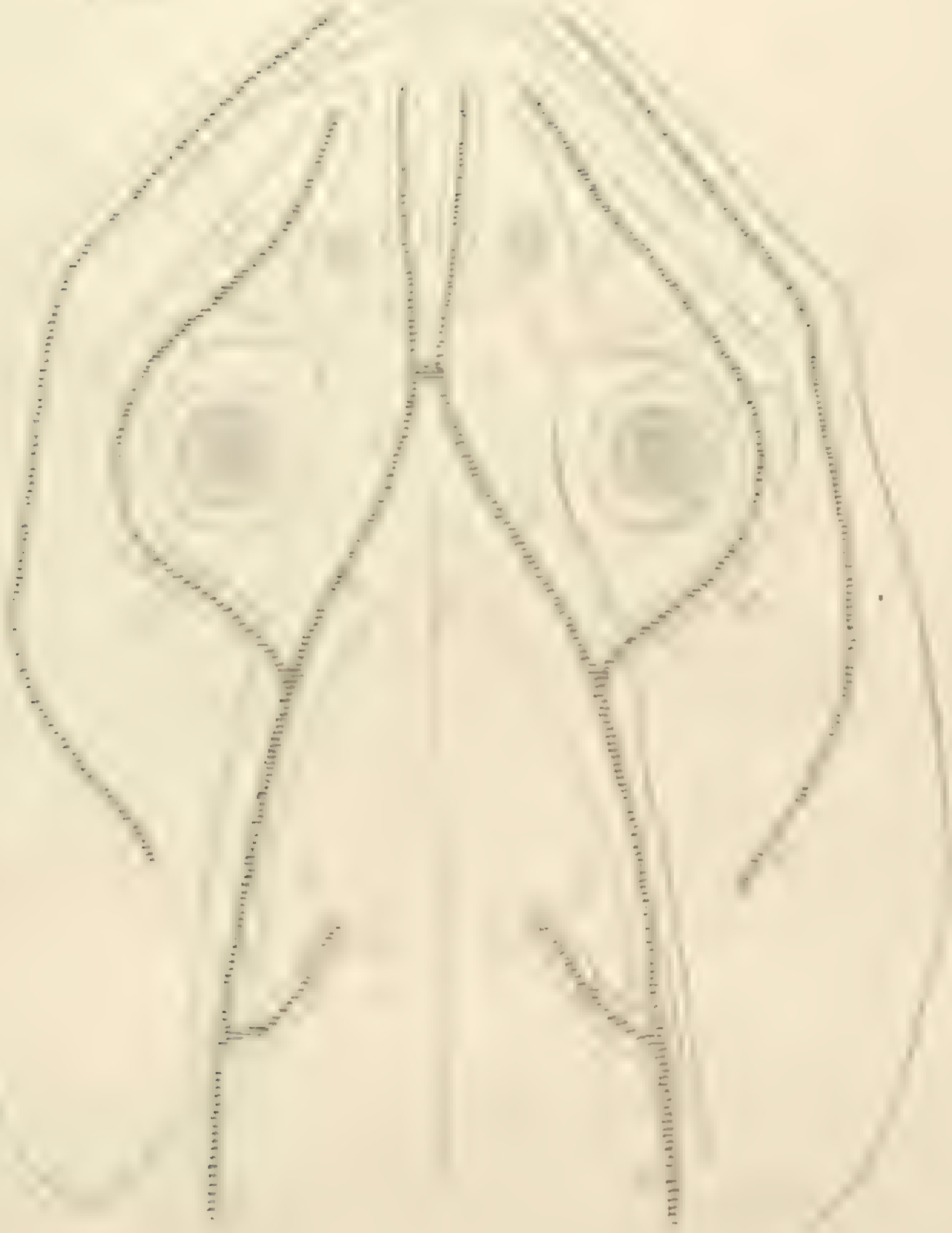

Fig. 2

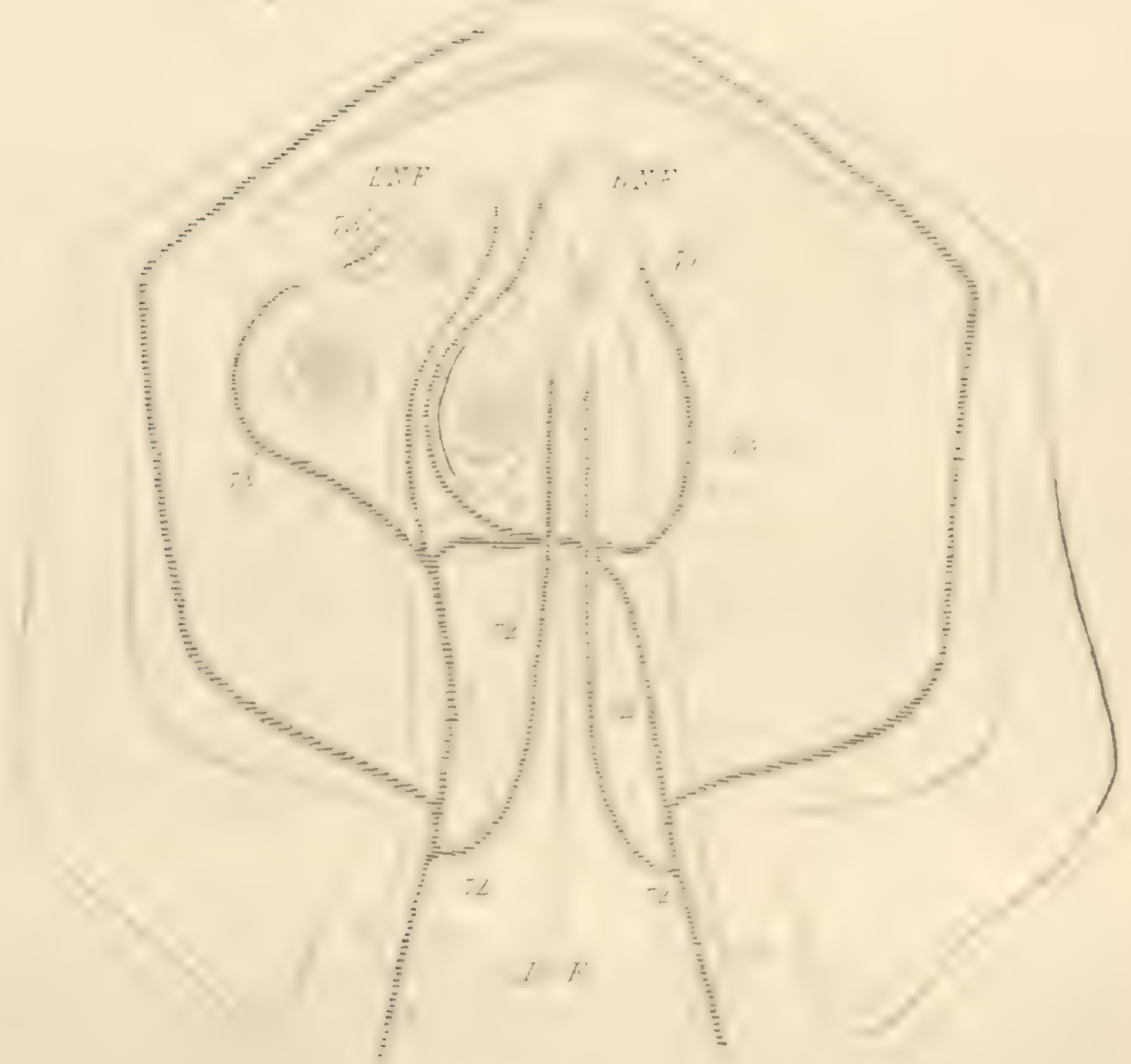
LNF
RNF
D
D
Z
Z
Z
Z
IF

Fig. 3

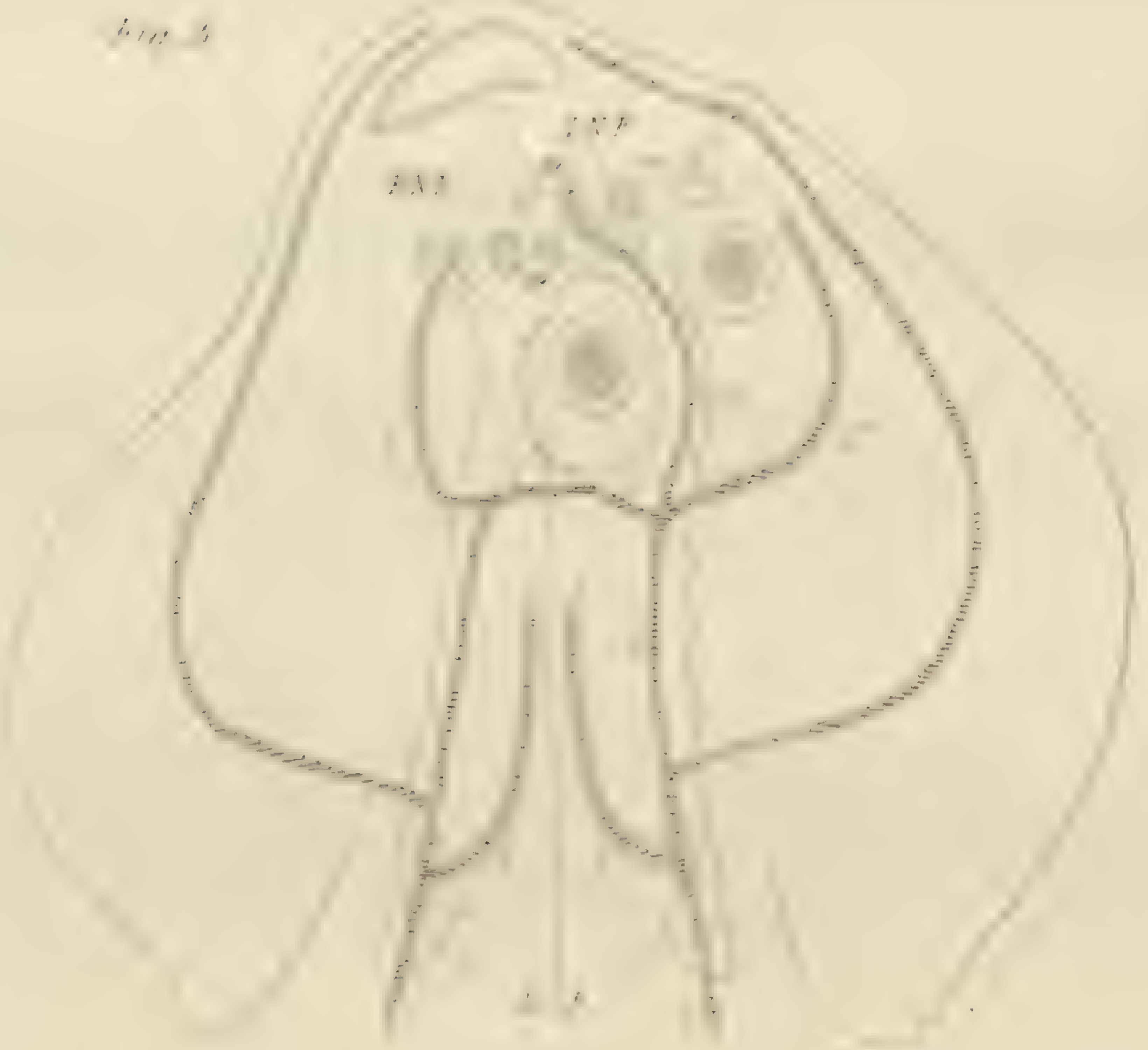

Fig. 4

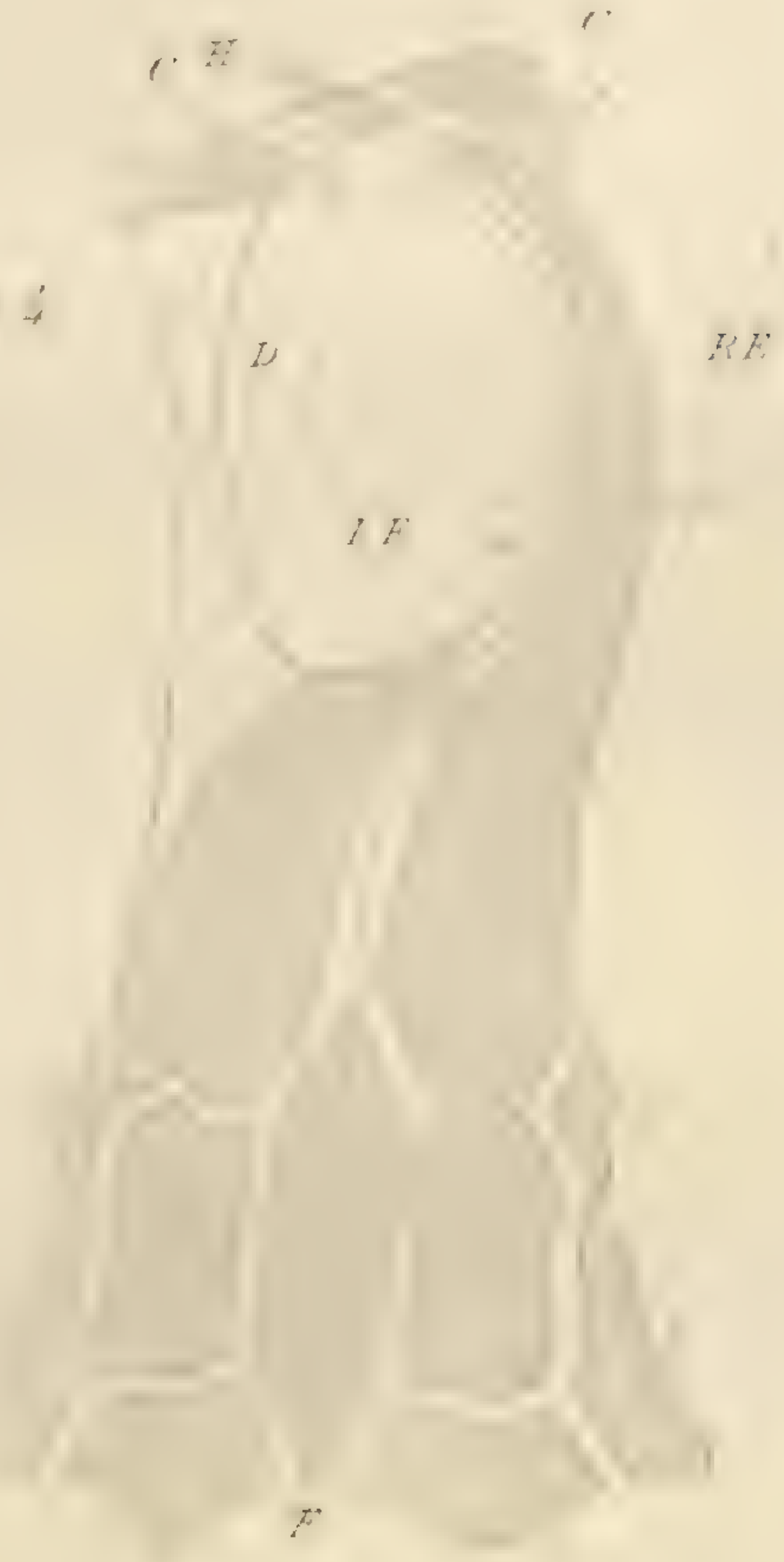

Fig. 8

Fig. 5

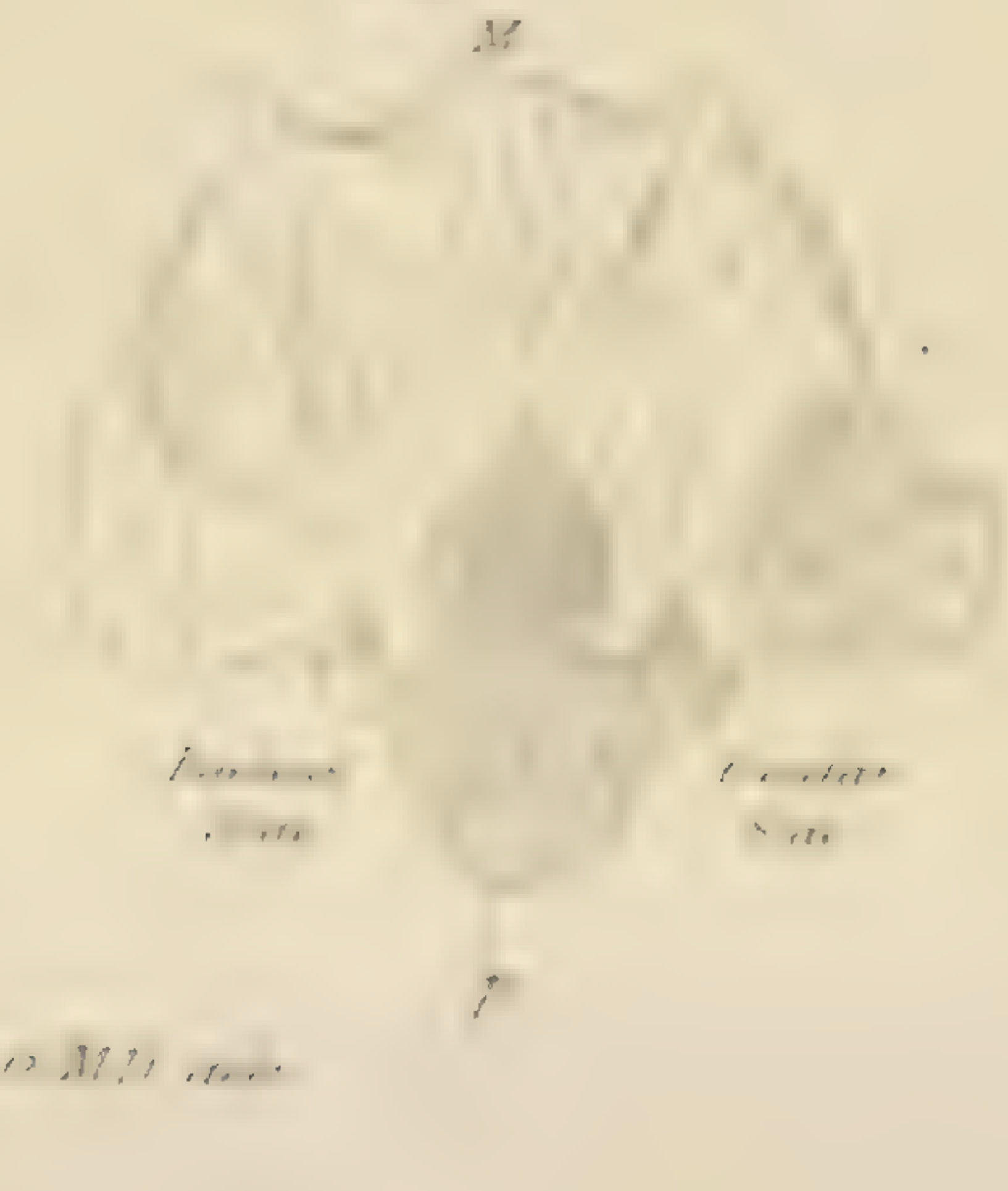

Fig. 6

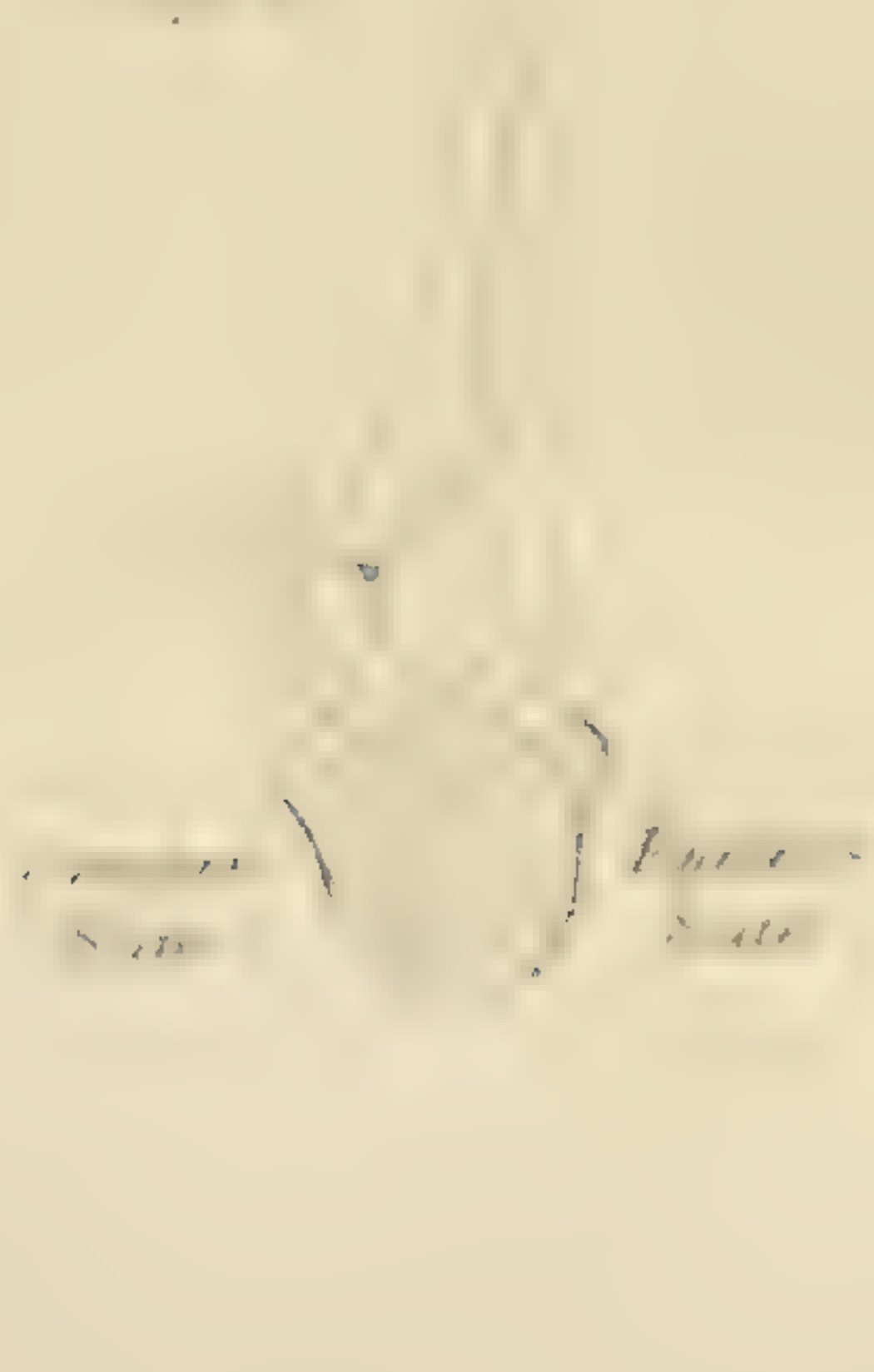

Fig. 7

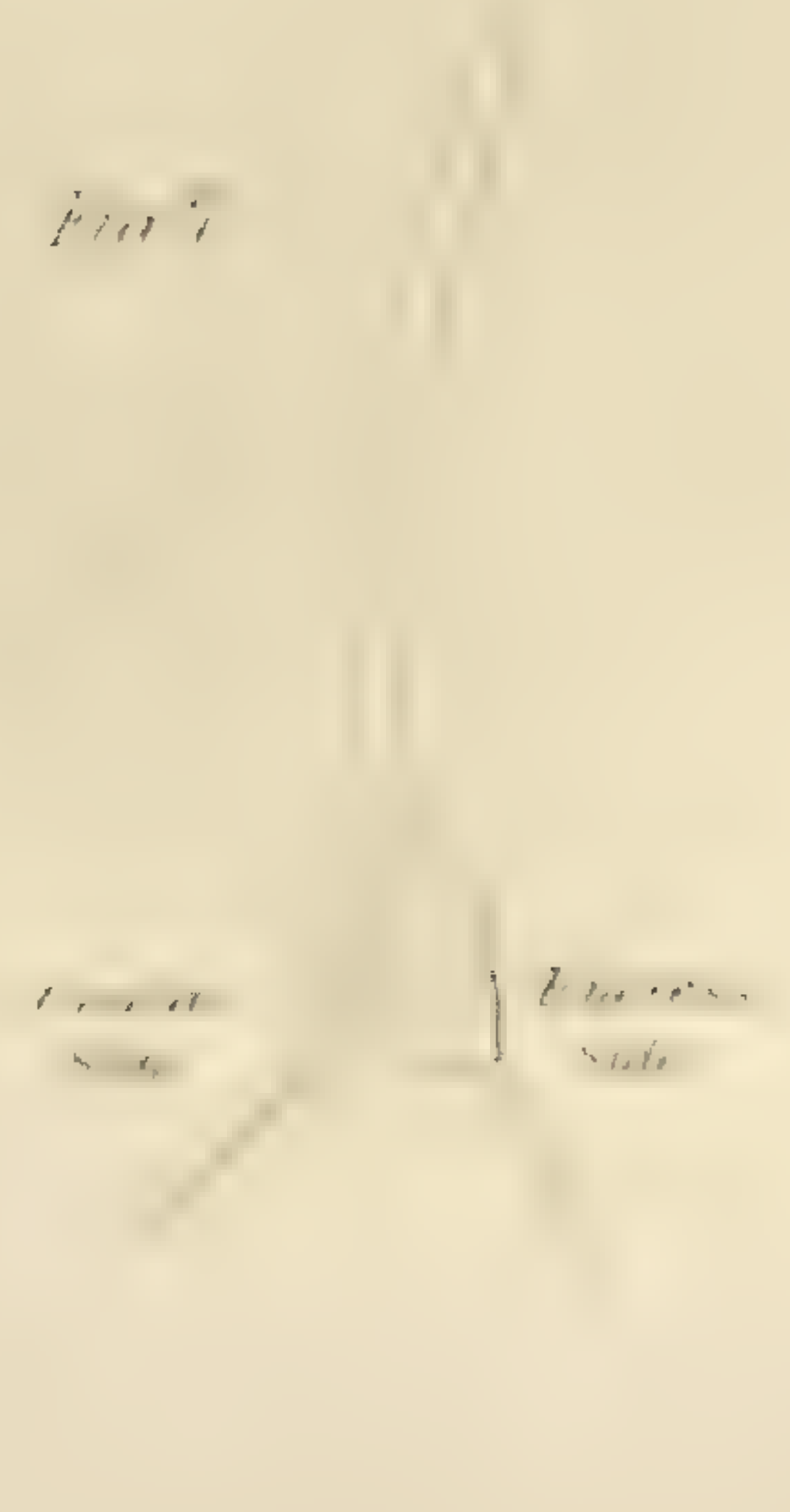

Fig. 9

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Edwin M Williams F.L.S. Sc.

29, 30. Lower jaw, hollowed out to contain the eight ampullæ of the operculo-mandibular canal.

8. Mastoid; and 11, left frontal: also hollowed, to support the ampullæ of the main canal.

14. Left prefrontal.

Fig. 8. Sketch of head and fore part of body of a monstrous specimen of *Platessa flesus*; the mucus-canals indicated in outline.

Fig. 9. Anterior part of the same fish, but seen from the eyeless side; the mucus-canals also indicated in outline. The lettering in both this and the preceding figure corresponds to that in figures 3 and 4.

Plate XXXII.

Fig. 1. Diagrammatic view of the mucus-canals and superficial face-bones on the head of the common Cod (*Gadus morrhua*).

a a a a. Mucus-canal of lateral line, extending along the top of the head, and ending in the turbinal ossicle (19), which is indicated in outline.

b. Supratemporal canal; supratemporal bones (72) also in outline.

c. Operculo-mandibular canal, which has no communication with the main canal in the Cod (Munro).

d. Suborbital canal; 73′, suborbital bones.

e. Cross commissure.

Fig. 2. Diagram of the corresponding parts in the Turbot.

a′. Left lateral canal.

b′. Left supratemporal branch, with the supratemporal ossicles indicated in outline.

c′. Left operculo-mandibular branch.

d′. Left suborbital canal and bones.

e. Commissural branch.

a. Right lateral canal, crossing the head beneath the dorsal fin (which is indicated by the line D F), and beneath both supratemporal canals, as it curves round between the eyes, side by side with its fellow of the left side.

b. Right supratemporal canal and chain of bones.

c. Right operculo-mandibular.

d. Right suborbital canal and bones.

19′. Left turbinal, and 19, right turbinal ossicle.

L N F. Left nasal fossa.

R N F. Right nasal fossa.

D F. Line of dorsal fin.

Fig. 3. Diagram of the corresponding structures in the Plaice. Here the eyes are placed upon the right side.

a′ *a*′. Right lateral canal, extending between the eyes all the way to the nose, where it ends in a well-marked "turbinal ossicle."

b′. Right supratemporal canal and range of ossicles.

c′. Right operculo-mandibular branch.

d′. Right suborbital branch and chain of bones.

d^{+}. Anterior suborbital bone of the right side, separate from the rest, and having no connexion with the mucus-canal.

a a. Left lateral canal, apparently stopping short at the commissure (*e*).

a^{+}. A small detached portion of that canal, being in fact its nasal extremity. Owing to, or at least coincident with, the imperfect development of the interocular process of the left frontal in the Plaice, the part of the left mucus-canal which should extend between the eyes in that process has likewise not been developed.

b. Left supratemporal canal.

c. Left operculo-mandibular canal.

d. Left suborbital branch and range of bones.

e. Commissure.

D F. Line of dorsal fin.

R N F. Right nasal fossa.

L N F. Left nasal fossa.

Fig. 4. Diagram of the top of the head in the Plaice, showing the manner in which the orbit is formed. The dotted line, D F, indicates the morphological middle line; the other dotted line, F H, shows the direction of the dorsal fin. The shaded parts are those parts of the original and symmetrical plan of the head which have become developed; the parts of the same plan which have not become developed are indicated in dotted outline, while the parts in entire outline are additional developments.

11′. Right frontal, with its interocular process (*m′*).

11. Left frontal, its interocular process atrophied, while a new process (*n*) has sprung from its external anterior angle.

14′. Right prefrontal, sending back a process (*a*) to articulate with the interocular part (*m′*) of the right frontal.

14. Left prefrontal—the part *a*, in dotted outline, and corresponding to the process (*a′*) of the bone of the other side, not having been developed, while a new process (*f*), not found on the right prefrontal, is sent back to articulate with the process (*n*) of the left frontal. By the union of the process (*f*) of the left prefrontal and the process (*n*) of the corresponding frontal, the "pseudo-mesial" bar of the cranium is formed, and the orbit bounded on the left side.

15. Nasal bone; the unshaded part indicates a development from its left side, which enters into the anterior boundary of the orbit, apparently pushing aside the left prefrontal.

C C. Olfactory foramina.

R E. Right eye.

L E. Left eye.

Fig. 5. Posterior surface f cranium of the Plaice. The dotted line, M P, shows the curve of the mesial line in this region, the convexity being towards the ocular or right side.

Fig. 6. First vertebra of the Plaice, seen from the front, showing how its mesial vertical plane is convex towards the right or ocular side.

Fig. 7. Seventh abdominal vertebra of the Plaice, seen from before, showing the more vertical direction downwards of the left transverse process.

Fig. 8. Abdominal vertebræ of the Plaice, seen from below, and showing the unsymmetrical obliquity of the transverse processes from the fifth to the twelfth inclusive.

Fig. 9. Anterior part of an embryo Flounder, magnified five times, showing the upper eye not yet fully turned round, and the dorsal fin not so far advanced on the head as we find it in the adult. The dorsal fin-rays are a little injured a little behind the head; but about the ocular region there is not the slightest trace of abrasion to be seen, so that there is no reason at all to suppose that *there* any rays have been removed by violence.

a. Line showing the natural size of the figured portion of the specimen.

IX. *Description of some New Genera and Species of Tropical* Leguminosæ.
By GEORGE BENTHAM, P.L.S.

(Plates XXXIII.–XLIII.)

Read May 4th, 1865.

I. MICROCHARIS, Benth. in Benth. et Hook. f. Gen. Pl. 501.
(Tribe GALEGEÆ. Tropical Africa.)

CHAR. GEN. Calycis parvi patentis lobi subæquales. Vexillum suborbiculatum, patens, lateribus reflexis, in unguem angustatum; alæ oblique obovato-oblongæ, carinæ vix adhærentes; carina obtusa, alis brevior. Stamen vexillare ima basi cum cæteris cohærens, a medio liberum, cætera in vaginam connata; antheræ uniformes. Ovarium sessile, pluriovulatum, in stylum brevem attenuatum, stigmate capitato subdiscoideo. Legumen lineare, compressum, membranaceum, 2-valve, intus inter semina tenuiter septatum. Semina transverse oblonga v. quadrata, estrophiolata, funiculis brevissimis.—Herbæ graciles, ramosæ, pilis simplicibus hispidæ. Folia simplicia, subsessilia. Stipulæ herbaceæ v. subulatæ, persistentes. Flores minimi, rubri, in racemos axillares dispositi. Bracteæ angustæ; bracteolæ 0.

The slender annuals with little scarlet flowers which constitute this genus are perhaps not uncommon in some parts of Tropical Africa; but being easily overlooked in the luxuriant vegetation of the moist regions they inhabit, they have only recently come to the knowledge of botanists. The first specimens seen were in the late Dr. Vogel's collections in the first Niger Expedition, and were stated on the ticket to have been gathered by his friend and companion, Dr. Roscher. They were, however, imperfect; and having probably been considered insufficient for identifying with any old genus, or describing as a new one, they were omitted in Hooker's 'Niger Flora.' Since then very complete specimens in flower and fruit were transmitted by the late Mr. Barter, who found them abundant after the rains in crevices of rocks on the Nupe, and also at Jeba on the Quorra; and a single specimen, in flower and young fruit, of what appears to be a second species of the same genus, was gathered by Dr. Kirk near Luabo, on the left bank of the Zambesi.

The general aspect of the genus is nearly that of some of the slender single-leaved Indigoferas or Tephrosias; but neither the inflorescence nor the floral characters agree precisely with either of those genera, and, technically, it appears to be more nearly allied to the tropical American and West-Indian Craccas. How far the two species here proposed may or may not prove to be varieties of one, can only be determined by a more extended series of specimens from intermediate stations.

The following are the specific characters of the two:—

1. M. TENELLA. (Plate XXXIII. A.) Foliis lanceolatis oblongisve, stipulis setaceis.

Caules graciles, laxe ramosi, 1–2-pedales, pilis patentibus hirti. Folia (sive foliola solitaria) late v. anguste lanceolata, rarius oblonga, acuta v. obtusiuscula, basi rotundata v. angustata, 1–1½ poll. longa, mem-

branacea, utrinque viridia, pilis longiusculis conspersa, in petiolum 1–2-linearem subarticulata. Stipulæ setaceæ, patentes v. incurvæ, rigidulæ, petiolo sublongiores. Racemi graciles, fere filiformes, folio sæpius longiores, hirti. Flores secus rhachin dissiti, ad axillam bracteæ setaceæ v. subfoliaceæ solitarii, breviter pedicellati, vix 2 lin. longi. Calyx brevis, pilis longiusculis rigidis hirtus. Petala pallide coccinea, glabra. Legumen leviter falcatum, hirtum, perfectum 8–9 lin. longum, 1 lin. latum, sed sæpe abortu brevius.

Hab. West tropical Africa. Rocks on the Niger (*Vogel, Barter*).

2. M. LATIFOLIA. (Plate XXXIII. B.) Foliis ovatis v. ovato-lanceolatis, stipulis late semicordatis subreniformibusve acuminatis.

Folia (sive foliola solitaria) 2 poll. longa, 1 poll. lata. Stipulæ foliaceæ, 2–4 lin. latæ. Cætera *M. tenellæ*, cujus forte varietas est insignis.

Hab. East tropical Africa. Near Luabo on the Zambesi (*Kirk*).

II. GEISSASPIS, W. et Arn.; Benth. et Hook. f. Gen. Pl. 516.

(Tribe HEDYSAREÆ. Tropical Asia and Africa.)

I refer to this well-known small genus for the purpose of characterizing a remarkable West-African species, in which the large bracts have not the marginal cilia of the common *G. cristata*. This plant has long been in our herbaria, having been gathered by Heudelot in Senegambia, and communicated by M. Delessert to Sir W. Hooker, as well as to myself, as early as 1838. In the Hookerian herbarium it has been correctly determined to be a *Geissaspis* by Dr. Planchon; but I do not find that it has ever been published as such. It is probable, however, that it is identical with the *Sœmmeringia psittacorhyncha* described by Webb, in his 'Spicilegia Gorgonea,' from a Cape-de-Verd-Island specimen which I have been unable to see. The character given is quite at variance with that of the Brazilian genus *Sœmmeringia*, and agrees, in all essential points, with our Senegambian *Geissaspis*.

The following are the technical characters of the species:—

G. LUPULINA, Planch. in herb. Hook. Stipulis latis basi oblique subcordatis vix productis, bracteisque integerrimis.

Herba annua glaberrima. Foliola 3–6-juga, anguste cuneato-oblonga, obtusissima, pleraque semipollicaria, petiolo communi gracili $\frac{1}{2}$–$\frac{3}{4}$ poll. longo. Stipulæ foliaceæ, oblique obovatæ v. subreniformes, 3–6 lin. longæ, basi sessiles v. hinc in auriculam minimam obtusam productæ. Spicæ lupulinæ, demum 1–2-pollicares, pedunculo foliis longiore fultæ. Bracteæ ut in *G. cristata* amplæ, oblique reniformes, venosæ, imbricatæ, 6–9 lin. latæ, sed integerrimæ nec ciliatæ. Petala bracteas parum excedentia. Flores et legumina cæterum omnino *G. cristatæ*.

Hab. West tropical Africa. Moist light soils on the banks of the Casamance, in Senegambia (*Heudelot*, nn. 555 and 664).

III. DESMODIUM, DC.; Benth. et Hook. f. Gen. Pl. 519.

(Tribe HEDYSAREÆ. Tropical and Subtropical Asia, Africa, and America, North America, Japan, Australia.)

This large offset from the old genus *Hedysarum* has been irregularly split up by various botanists, but chiefly by separating as distinct genera isolated species which pre-

sented characters that had not been observed in others. In the first general sketch of the group which I made for the 'Plantæ Junghuhnianæ,' it appeared to me that if the universally adopted genera *Dicerma* and *Nicolsonia* of De Candolle were maintained, it would be necessary to keep up several others, and even to establish new ones, for which I gave characters in a note to that work. I have, however, since then had occasion to examine in detail above a hundred species, besides numerous varieties published as species; and the characters relied on for the separation of the smaller genera have proved too uncertain or too artificial to be available for any but sectional divisions; so that in our 'Genera Plantarum' I have found it necessary not only to restore the genus to the extent originally contemplated by De Candolle, but to add to it his *Dicerma* and *Nicolsonia*, which are now shown to be less different from several of his Desmodiums than these are from each other. The minor characters have served to distinguish twelve sections, besides four subsections of *Heteroloma*; and it is with much hesitation that I refrained from adding to them the small or monotypic genera *Ougeinia*, Benth., *Mecopus*, Benn., and *Pseudarthria*, W. et Arn., closely connected as they are with some species of true *Desmodium*. On the other hand, the pod of *Nicolsonia congesta*, Wight, is so very different from that of all the other sections, that I have been obliged to raise it to the rank of a genus, under the name of *Leptodesmia*, which I had formerly proposed as sectional in *Desmodium*, the two species described in the 'Plantæ Junghuhnianæ,' ix. 222, taking the names of *L. congesta* and *L. lespedezioides*.

Among the recent additions to *Desmodium* are the two following, remarkable for their pinnate leaves with more than three leaflets (an exceptional form which, in the whole subtribe of *Desmodieæ*, had hitherto been known only in a very few species of *Uraria*):—

D. (HETEROLOMA) PYCNOSTACHYUM, sp. n. Foliis pinnatis, foliolis quinis ovali-ellipticis oblongisve obtusissimis v. emarginatis supra glabris subtus ramisque pilis raris conspersis, stipulis subcordatis patentissimis, racemis densis terminalibus, bracteis parvis caducissimis, pedicellis brevibus, legumine hamato-pubescente pluriarticulato sutura superiore subcontinua inferiore profunde sinuata.

Erectum videtur, ramosum et forte fruticosum. Foliola fere *D. concinni* at semper in speciminibus 5; terminale 1–1½-pollicare, lateralia minora. Stipulæ siccæ rigidulæ, acuminatæ, striatæ, 1–2 lin. longæ, demum deciduæ. Inflorescentia, flores et fructus fere *D. polycarpi*; bracteæ tamen parvæ, setaceo-acuminatæ nec comosæ.

Hab. Isle of Pines, off the coast of New Caledonia (*M'Gillivray*).

D. (HETEROLOMA, PODOCARPIA) OLDHAMI, Oliv. in Journ. Linn. Soc. ix. 165. Foliis pinnatis, foliolis subseptenis ovato-lanceolatis pilis adpressis conspersis, racemo elongato longe pedunculato laxe pubescente, bracteis angustis persistentibus, leguminis longe stipitati articulis paucis longe semiovatis.

Caules elongati, simplices v. parum ramosi. Folia pauca, foliolo terminali 1½–2½-pollicari, lateralibus minoribus. Racemi semipedales, rigiduli. Bracteæ lineari-lanceolatæ. Pedicelli solitarii v. gemini altero abbreviato. Calyx fere cyathiformis. Leguminis nondum maturi stipes 3 lin. longus; articuli 1–2, fere triangulares, 3 lin. longi, medio 1½ lin. lati.

Hab. Japan (*R. Oldham*, 1862).

IV. MASTERSIA, Benth. in Benth. et Hook. f. Gen. Pl. 535.

(Tribe PHASEOLEÆ. Tropical Asia.)

CHAR. GEN. Calycis lobi 2 superiores in unum integrum latum connati. Vexillum suborbiculatum, brevissime unguiculatum, exauriculatum; alæ oblique oblongæ; carina lata, leviter incurva, obtusa, alas subæquans. Stamen vexillare liberum, filamento filiformi a basi recto; antheræ (5? v. omnes?) lineares, versatiles. Ovarium sessile, multiovulatum; stylus brevis, incurvus, filiformis, imberbis, stigmate capitato. Legumen oblongo-lineare, plano-compressum, indehiscens, sutura superiore anguste subalata. Semina plurima, parva, transverse oblonga, hilo parvo laterali, funiculo filiformi.—Caulis alte volubilis. Folia pinnatim 3-foliolata, foliolis amplis stipellatis. Flores in pedunculis elongatis axillaribus fasciculato-racemosi, fasciculorum rhachi nodiformi. Bracteæ caducissimæ; bracteolæ suborbiculatæ, diutius persistentes.

The plant upon which I propose to found this genus is a large twiner, collected many years since by Drs. Wallich and Griffith in their joint expedition into the Assam tea-country. The majority of specimens are in fruit only, but a few flowering ones from Dr. Griffith's collection, although not in a very good state, have proved sufficient to complete the generic character. The affinity is evidently with *Pueraria* and *Dioclea*, both as to habit and the general structure of the flower; but the stamens are different, and the thin flat indehiscent pod and the position of the seeds are quite anomalous amongst *Phaseoleæ*.

I have dedicated the genus to Mr. Masters, after whom his friend the late Dr. Griffith, in testimony of his assiduous investigation of the Assam flora, had named a genus which afterwards proved to have been previously published under another name. We may, however, also consider *Mastersia* as commemorating the labours of Dr. T. Maxwell Masters, F.L.S., several of whose papers on Vegetable Teratology, as well as on Systematic Botany, have already appeared in the publications of our Society.

The following is the detailed description of the species:—

M. ASSAMICA, sp. n. (Plate XXXIV.)

Caules alte volubiles, glabriusculi. Foliorum petiolus communis semipedalis; foliola late ovata, breviter acuminata, 3–6 poll. longa, integra, tenuiter coriacea, supra glabra, subtus pilis adpressis conspersa, petiolulo 2–3 lin. longo. Stipulas caducissimas non vidi; stipellæ rigidulæ, lanceolatæ v. oblongæ. Racemi pedales et longiores, nonnunquam prope basim folium ferentes. Florum fasciculi dissiti, rhachibus interdum demum paullo elongatis, vix tamen lineam attingentibus. Pedicelli graciles, pubescentes, 2–3 lin. longi. Bracteæ ad nodum quemque 2, oppositæ, ovatæ, 3–4 lin. longæ, præter cilia marginalia glabræ, longe ante anthesin caducæ. Bracteolæ suborbiculatæ, 2 lin. longæ. Calycis tubus 1 lin. longus; lobi acuti, superiores 3 lin. longi, summo latissimo, lateralibus angustis, infimus longior, arcuatus, carinatus. Vexillum fere 6 lin. longum; petala inferiora vix breviora. Ovarium villosum. Legumen sessile, tenue sed rigidulum, glabrum, nitidum, 2–4 poll. longum, $\frac{3}{4}$–1 poll. latum. Semina plus quam 20, in medio legumine 1-seriatim disposita.

Hab. East India. Mishmee hills, and near Choonpura in Upper Assam (*Wallich and Griffith*).

V. PANUREA, Spruce, in Benth. et Hook. f. Gen. Pl. 550.

(Tribe SOPHOREÆ. Tropical America.)

CHAR. GEN. Calycis oblique turbinati lobi breves, lati; 2 superiores in labium bidentatum connati. Petala breviter unguiculata; vexillum suborbiculatum; alæ oblique ovatæ; carinæ petala libera, alis breviora

sed cæterum similia. Stamina libera; antheræ parvæ, subglobosæ. Ovarium sessile, pauciovulatum; stylus brevis, crassus, uncinato-inflexus, stigmate terminali truncato. Legumen planum, acuminatum, bivalve. Arbor ramosissima. Folia simplicia, ampla, penninervia. Stipulæ parvæ. Flores parvi, racemosi, racemis brevibus ad axillas breviter subpaniculatis. Bracteæ parvæ, caducæ; bracteolæ minutæ v. inconspicuæ.

Species unica P. LONGIFOLIA, Spruce, MS. (Plate XXXV.)

Arbor fide Sprucei 20–30-pedalis, ramis adscendentibus, tota glabra exceptis inflorescentia ramulisque novellis tenuissime rufo-tomentellis. Folia (foliola solitaria?) oblongo-elliptica, breviter acuminata, basi obtusa, coriacea, nitidula; maxima ultrapedalia, suprema multo minora; petiolo (petiolulo?) brevi crasso fulta. Racemi 1–3-pollicares, ad axillas solitarii v. subfasciculati, simplices v. ramosi. Pedicelli solitarii v. subfasciculati, calyce subbreviores. Calyx 1½ lin. longus. Petala ochroleuca, calyce vix duplo longiora.

Hab. Tropical America. Caatingas near Panuré, on the Rio Uaupés, in North Brazil; gregarious, and often covering acres of ground among the scattered large forest-trees (*R. Spruce*, n. 2586).

The inflorescence, the small flowers, and in a great measure the calyx, petals, and even the anthers, are very near those of *Dalbergia*; but the stamens are entirely free, placing the genus amongst *Sophoreæ*, where I know of no one resembling it in other respects. I have not seen the pod: Mr. Spruce describes it as flat, rather broad, acuminate, and 2-valved, and he believes he had laid some in with the specimens; but they appear to have been unfortunately lost before transmission to this country.

VI. CAMOËNSIA, Welw.; Benth. et Hook. f. Gen. Pl. 557.

(Tribe SOPHOREÆ. Tropical Africa.)

CHAR. GEN. Calycis campanulati v. longissimi lobi imbricati. Petala papilionacea, unguiculata, corrugata; vexillum late orbiculatum; 4 inferiora lato-ovata v. anguste cuneata, libera. Stamina libera; antheræ uniformes, lineares, versatiles. Ovarium stipitatum, pluriovulatum; stylus filiformis, in alabastro involutus, stigmate terminali parvo v. capitato. Legumen lato-lineare, plano-compressum, crasso-coriaceum, bivalve. Semina transversa, obovata, compressa; albumen 0; radicula brevis, recta.—Frutices alte scandentes. Folia digitatim 3-foliolata, foliolis amplis coriaceis petiolulatis. Flores speciosi, racemosi, racemis in axillis superioribus simplicibus. Bracteæ et bracteolæ breves, caducæ.

This genus stands alone in *Leguminosæ*, as combining the lofty climbing woody stem and habits of many *Dalbergieæ* with the digitately trifoliolate leaves of *Podalyrieæ* and *Genisteæ*, whilst the flowers place it amongst *Sophoreæ*. Both the species known are amongst the handsomest of the Order, and the flowers of one are certainly the largest hitherto known. It has therefore been appropriately dedicated by Dr. Welwitsch to the celebrated Portuguese poet Luis Camoes, author of the 'Lusiade,' in which is introduced the voyage of discovery of Vasco di Gama, which he had himself accompanied in his youth as a soldier.

1. C. MAXIMA, Welw. (Plate XXXVI.) Calyce longissime tubuloso ovarioque rufo-lanatis.

"Frutex validus altissime scandens, dein graciose dependens" (*Welw.*). Specimina, inflorescentia excepta, glabra. Foliola ad apicem petioli, brevissime petiolulata, obovali-oblonga v. late elliptica, anguste acuminata, infra medium angustata, basi obtusa, tenuiter coriacea, reticulato-pennivenia,

6-pollicaria, petiolo communi foliolis breviore. Stipulæ nunc persistentes rigidæ conicæ incurvæ spinescentes, nunc evanidæ; stipellæ subulatæ. Flores maximi, penduli, in racemos breves axillares dispositi, rhachi bracteis calycibusque molliter rufo-lanatis. Pedicelli brevissimi, crassi. Bracteæ et bracteolæ lineari-lanceolatæ, setaceæ, acuminatæ, caducæ. Calyces 6–7-pollicares, parte discifera tenuiore 3–4 poll. longa, parte libera paullo ampliore at pariter tubulosa, ad medium in labia 2 fissa, labio superiore breviter 2-fido, inferiore 3-partito, lobis margine leviter imbricatis, labii inferioris sæpius revolutis. Petala lactea, venosa, marginibus crispulis aureo-marginatis, in ungues calycis lobos subæquantes angustata; vexillum suborbiculatum, calycem pollices 4 excedens; 4 inferiora minora et multo angustiora. Stamina petalis paullo breviora, glaberrima; antheris longe linearibus medifixis. Ovarium dense rufo-lanatum; stylus staminibus longior, superne glabratus, stigmate globoso-capitato. Legumen rufo-lanatum, angulo recto in stipitem recurvum, 6–8 poll. longum, 1–1½ poll. latum, suturis parum incrassatis. Semina sæpius 3–4.

Hab. West tropical Africa. Common in dense forests of the Golungo Alto, adorning the loftiest trees of the outskirts with its splendid bunches of pendulous milk-white flowers tinged with gold on the edge of the petals (*Welwitsch*). Specimens are also in the British Museum, from Afzelius's collection, of what appears to be a slight variety, with much smaller flowers, but of the same shape as in Welwitsch's specimens, and much larger than in *C. brevicalyx*.

2. C. BREVICALYX, sp. n. Calyce late campanulato ovarioque minute tomentellis.

Frutex, fide Mannii alte scandens, glaber, excepta inflorescentia minute tomentella. Foliola ovali-elliptica v. late oblonga, obtusa v. brevissime obtuseque acuminata, demum coriacea nitida, pleraque 3–6-pollicaria, petiolulo 2–3 lin. longo fulta, petiolo communi foliolis parum breviore v. interdum longiore. Stipulæ brevissimæ, latæ, squamiformes, rigidæ at non spinescentes; stipellas non vidi. Flores speciosi (albi?), in racemos axillares laxos pedunculatos foliis longiores dispositi. Pedicelli semipollicares. Bracteæ et bracteolæ breves, latæ, concavæ, squamiformes, deciduæ. Calyces subpollicares, parte discifera tenui ½ poll. longa, parte libera late campanulata, in alabastro angulata, per anthesin usque ad medium in lobos 5 leviter imbricatos divisa, superioribus vix altius connatis. Petala in ungues calyce longiores angustata; vexillum suborbiculatum lamina subsesquipollicari, 4 inferiora paullo breviora et angustiora. Stamina petalis paullo breviora. Ovarium stipitatum, rufo-tomentellum; stylus elongatus, superne glabratus, stigmate parvo. Legumen non visum.

Hab. West tropical Africa. On the river Muni, lat. 1° N. (*G. Mann*).

Had it not been for the comparison with its magnificent congener, this would have been reckoned a most showy large-flowered climber. I have not seen it in any other collection.

VII. BATESIA, Spruce, in Benth. et Hook. f. Gen. Pl. 563.

(Tribe SCLEROLOBIEÆ. Tropical America.)

CHAR. GEN. Calycis tubus discifer campanulatus; segmenta 5, imbricata. Petala 5, parum inæqualia, ovata, imbricata, summo intimo. Stamina 10, libera, filamentis basi villosis, vix declinatis; antheræ uniformes, loculis longitudinaliter dehiscentibus. Ovarium breviter stipitatum, in fundo calycis liberum, pauciovulatum, stipite apice oblique dilatato subarticulato; stylus brevissimus, crassus, stigmate terminali truncato concavo ciliato. Legumen breve, subfalcatum, compresso-turgidum, coriaceo-sublignosum, costis elevatis percursum, folliculatim dehiscens. Semina 2–3, transversa, suborbiculata, crasso-compressa, exarillata, albuminosa; cotyledones planæ, carnosulæ, basi cordatæ; radicula brevis recta.—Arbor procera, inermis. Folia ampla, imparipinnata, foliolis coriaceis. Flores lutei, racemosi, racemis ad apices ramorum in paniculam amplam ramosissimam dispositis. Bracteæ et bracteolæ angustæ, caducissimæ.

The genus thus named in honour of the distinguished traveller on the Amazons, H. W. Bates, Esq., is founded on a lofty tree discovered by Mr. Spruce in the forests bordering the Rio Uaupés in North Brazil, and referred doubtfully, in the distribution of his plants, to *Tachigalia.* It differs, however, from that genus in the unequally pinnate leaves and in the stipes of the ovary being entirely free from the calyx-tube (which remove it from the subtribe *Amherstieæ* to the *Sclerolobieæ*)—as well as in the pod, which is peculiar in its dehiscence. I am only acquainted with a single species:—

B. FLORIBUNDA, Spruce, MS. (Plate XXXVII.)

Arbor fide Sprucei 100-pedalis coma patula, ramulis inflorescentia petiolis foliolorumque pagina inferiore tenuiter rufo-tomentellis. Folia 1–2-pedalia; foliola sæpius 11, petiolulata, ovali-elliptica v. oblonga, acuminata, basi obtusa, 4–6-pollicaria, supra glabra nitidaque, subtus elevate pennivenia et transverse reticulato-venulosa. Petiolus communis angulatus, nonnunquam inter foliola ultima glandulas iis *Ingæ* subsimiles gerens. Flores aurei, odorati, in paniculas amplas floribundas terminales dispositi, secus ramulos ultimos racemosi. Bracteas non vidi; bracteolæ lineares, breves, caducissimæ. Calycis segmenta 3 lin. longa. Petala paullo longiora, anguste ovata, extus minute tomentella. Stamina petalis breviora, antheris ovatis. Legumen brevissime stipitatum, 1–1½ poll. longum, fere ¾ poll. crassum. Semina nitide coccinea.

Hab. Tropical America. Forests of the Rio Uaupés, in North Brazil (*R. Spruce*, n. 2780); distributed under the name of *Tachigalia ? erythrosperma.*

VIII. DICYMBE, Spruce, in Benth. et Hook. f. Gen. Pl. 564.

(Tribe SCLEROLOBIEÆ. Tropical America.)

CHAR. GEN. Calycis tubus discifer turbinatus, crassus; segmenta 4, ovali-oblonga, imbricata, summo sæpe bifido. Petala 5, ovata, parum inæqualia, imbricata, summo intimo. Stamina 10, libera, filamentis inflexis basi pilosis; antheræ lineares, uniformes, loculis longitudinaliter dehiscentibus. Ovarium breviter stipitatum, in fundo calycis liberum, ∞-ovulatum; stylus elongatus, æstivatione involutus, stigmate peltato. Legumen . . . . —Arbor. Folia abrupte v. subimparipinnata. Flores corymboso-paniculati. Bracteæ crassæ, cochleatæ, caducissimæ. Bracteolæ 2, crasso-coriaceæ, sibimet valvatim applicitæ et ante anthesin globum constituentes alabastrum includentem, per anthesin apertæ, persistentes.

I had long hesitated whether or not to adopt this genus as distinct from *Thylacanthus*, Tul., the affinities with which were recognized by Mr. Spruce. Neither he nor myself have seen any specimen of Tulasne's plant; but, from the detailed description given by that author, the calyx divided to the base into 5 petal-like segments, the stamens united at the base, the short anthers, and the bracteoles united into a 2-lobed involucre are all incompatible with Spruce's plant, establishing differences analogous to those which separate *Brownea*, *Amherstia*, and their allies from each other. It is not impossible, however, that, when better known, it may be found advisable to reunite *Dicymbe* with *Thylacanthus.* It is said by Mr. Spruce to be a small but handsome tree, the large, thick, ivory-like bracteoles giving the inflorescence a remarkable aspect.

The following is the detailed description of the only species known:—

D. CORYMBOSA, Spruce, MS. (Plate XXXVIII.)

Arbor, fide Sprucei parva, raro altitudine 30 pedes attingens, plerumque 10–15-pedalis, inflorescentia excepta glabra, ramulis crassis. Folia sæpius abrupte pinnata, 2-juga, hinc inde 1- v. 3-foliolata;

foliola sæpe inæqualia, oblongo- v. ovali-elliptica, obtuse acuminata, basi angustata, coriacea, nitida, maxima fere pedalia, pleraque tamen dimidio minora, petiolo communi brevi, petiolulis brevissimis. Stipulæ ad folia adulta inconspicuæ. Flores majusculi, ad apices ramorum in corymbum fastigiatum dispositi, secus ramos breviter racemosi. Pedicelli rigidi, 2-pollicares. Bracteas non vidi. Bracteolæ eburneæ, subpollicares, crassissimæ, concavæ. Sepala seu calycis segmenta crassiuscula, bracteolis parum breviora, eburnea, extus puberula, summo latiore sæpe bifido. Petala sepalis paullo longiora et tenuiora, alba, margine undulata v. crispula, extus puberula. Ovarium breviter rufo-tomentosum, ovulis ad 8.

Hab. Tropical America. Common in the Caatingas or sandy woods near Panuré, on the Rio Uaupés, North Brazil (*Spruce*, n. 2791).

IX. GLEDITSCHIA, Linn.; Benth. et Hook. f. Gen. Pl. 568.

(Tribe EUCÆSALPINIEÆ. North America, temperate Asia, and tropical Africa.)

The affinities of this genus had much perplexed me; the inflorescence, small flowers, and general habit seemed to indicate an approach to *Mimoseæ*, but the floral characters are quite different; and I had not till lately the opportunity of examining any but male flowers of *Gymnocladus*, next to which it had been placed by De Candolle and others. Having now, however, received good hermaphrodite or female flowers from Dr. A. Gray, the close connexion of the two genera has become evident. Both have polygamous flowers, with the calyx-lobes not completely covering all the petals in the bud, so that some of the latter assume almost the appearance of sepals, as in some *Passifloreæ* and allied orders, but which is very unusual in *Leguminosæ*; and *Gymnocladus* occasionally has a few pinnæ of the leaves reduced to simple leaflets, as is frequently the case in *Gleditschia*. The chief differences consist in the larger flowers, longer calyx-tube, and thick pod of *Gymnocladus*; and both genera come well into *Eucæsalpinieæ*, next to *Acrocarpus* and *Wagatea*.

Gleditschia had hitherto been supposed to be confined to North America and temperate or subtropical Asia, our herbaria containing two species from North America, one or perhaps two from China, and one from the Caspian region; but, after the sheet of our 'Genera Plantarum' containing the genus had been printed off, Dr. Welwitsch communicated to me specimens of a distinct species gathered by him in the mountains of the Huilla district, in West tropical Africa. The generic characters are precisely those of the northern species, and the inflorescence that of *G. triacanthos*, or even more dense, whilst the pod is intermediate, as it were, between those of *G. caspica* and *G. monosperma*. The following are the detailed characters:—

G. AFRICANA, Welw. MS. Molliter pubescens, vix demum glabrescens, foliis (omnibus ?) bipinnatis, foliolis ovatis obtusis retusisve, spicis densis, floribus subsessilibus molliter villosis, legumine subrecto oligospermo.

Arbor (fide Welw.) mediocris, coma dilatata, ramulis novellis foliis inflorescentiaque molliter pubescentibus villosisve. Foliorum pinnæ oppositæ, abrupte 3–4-jugæ v. rarius 2–3-jugæ cum impari; foliola in quaque pinna 8–13, alterna, ¾–1½ poll. longa, basi æqualiter obtusa v. obliqua, coriacea, juniora utrinque molliter villosa, adulta nonnunquam supra fere glabra nitidaque. Stipulæ inconspicuæ. Glandulæ interdum adsunt parvæ inter pinnas cujusve jugi. Spicæ molliter villosæ, densæ, v. basi

interruptæ, 1½–3 poll. longæ, sæpius paucæ in paniculam brevem terminalem dispositæ. Flores ex albido flavescentes, sessiles, secus rhachin solitarii v. fasciculati, fasciculis infimis nonnunquam brevissime pedunculatis, plerique 5-meri, 2 lin. longi. Calycis tubus discifer turbinatus, lobi oblongo-lineares, obtusi, villosi, tubo paullo longiores, parum inæquales. Petala calycis lobos parum excedentia, angusta, villosa. Stamina inæqualia, petalis longiora, filamentis crassiusculis parce pilosis; antheræ ovatæ, purpureæ. Ovarium stipitatum, stipite a calyce libero, villosum, in stylum brevem glabrum attenuatum; ovula 6–8. Legumen stipitatum, planum, fere rectum, obtusum, coriaceum, glabrum v. pilis paucis conspersum, 4–6 poll. longum, 1 poll. latum, suturis vix incrassatis.

Hab. West tropical Africa. Gathered in the Huilla distict in the dense rocky forests about Mumpulla, at an elevation of about 4000 feet (in flower and fruit), and in the district of Pungo Andongo, in the woods near Calundo, at an elevation of between 2400 and 3800 feet (in fruit only) (*Welwitsch*).

X. OLIGOSTEMON, Benth. in Benth. et Hook. f. Gen. Pl. 578.

(Tribe CASSIEÆ. Tropical Africa.)

CHAR. GEN. Calycis tubus nullus; sepala 4, ampla, externo infimo subcoriaceo secundoque summo majore subpetaloideo ovatis integris, tertio ovato-lanceolato hinc basi sublobato, quarto profunde 2-lobo, lobis lanceolatis petaloideis sed aveniis. Petala 5, sepalis multo minora, 3 superioribus lanceolatis v. ovato-lanceolatis, summo extimo, 2 inferioribus minoribus linearibus. Stamina 5, rarius 4, filamentis brevissimis planis liberis; antheræ elongatæ, basifixæ, apice 2-fidæ, loculis acuminatis longitudinaliter sulcatis superne rima brevi dehiscentibus, 3 staminum superiorum dorso longitudinaliter connatæ, 1–2 laterales liberæ. Ovarium breviter stipitatum, longitudinaliter 4-alatum, 2-ovulatum; stylus crassiuscule filiformis, stigmate parvo terminali. Legumen junius elongatum, acuminatum, longitudinaliter 4-alatum. Semina . . . .—Frutex elatus. Folia imparipinnata. Flores in racemum terminalem dispositi.

The handsome, richly-flowering, tall shrub on which this genus is founded, a native of tropical Africa, is, like several others from the same country, perfectly isolated by its characters, combining those of very different tribes. The most important of them, and especially the structure and arrangement of the stamens, refer it, without doubt, to Cassieæ; whilst the æstivation of the petals, the upper one outside as in Papilionaceæ, is, I believe, a solitary exception in the whole suborder of Cæsalpinieæ. In other respects the structure of the flower, as well as the habit, show considerable affinity to the Brazilian genus *Martia*; the veined petals are nearly those of *Tamarindus*. Our drawing was unfortunately taken from the first specimens we had, which were only commencing to flower. Others more advanced were afterwards received, in which the terminal raceme had lengthened to above a foot; and some of the pods were already much enlarged, but not nearly sufficiently so to ascertain their dehiscence, if any, or to show the structure of the seed. The following is the only species known:—

O. PICTUS, Benth. (Plate XXXIX.)

Frutex fide Mannii 12–20-pedalis, partibus novellis inflorescentiaque minute rufo-tomentellis, cæterum glaber. Foliola 7–9, petiolulata, opposita cum impari, obovali-elliptica, apice rotundata et abrupte acuminata, acumine mucronulato, basi acutiuscula, 4–5-pollicaria, tenuiter coriacea, pennivenia et reticulato-venulosa. Stipulæ parvæ, latiusculæ, acutæ, caducæ. Flores rosei, sepalis exterioribus brunneis, in racemum densum demum ultrapedalem terminalem dispositi. Pedicelli subsemipollicares v. demum longiores, crassiusculi, supra basin persistentem articulati, ad articulationem bibracteolati,

bracteolis bracteisque subtendentibus parvis squamiformibus caducis. Sepalum externum 9–10 lin., intermedia 12 lin., intimum 15 lin. longa. Petala eleganter venosa, 3 sepalis dimidio fere breviora, intermedio tamen lateralibus paullo longiore et acutiore, 2 parva angusta. Antheræ semipollicares. Legumen immaturum jam 5 poll. longum, 5 lin. latum.

Hab. West tropical Africa, on the Cameroon river (*G. Mann*).

XI. BANDEIRÆA, Welw., and Benth. et Hook. f. Gen. Pl. 577.

(Tribe Bauhinieæ. Tropical Africa.)

Char. Gen. Calycis tubus discifer elongatus; limbus laxe campanulatus, lobis 5 brevibus latis subimbricatis. Petala 5, oblonga, erecta, subæqualia, imbricata, summo intimo. Stamina 10, libera, glabra, subdeclinata; antheræ uniformes, versatiles, loculis longitudinaliter dehiscentibus. Ovarium longe stipitatum, stipite tubo calycis adnato et longe exserto, ∞-ovulatum; stylus brevis, stigmate parvo terminali. Legumen longe stipitatum, oblique oblongum, compressum v. turgidum, stylo persistente infra apicem uncinatum, coriaceum, 2-valve. Semina 1 v. pauca (matura ignota).—Frutices alte scandentes. Folia simplicia (1-foliolata), pennivenia v. costis lateralibus tenuibus 3-nervia. Flores speciosi, racemis terminalibus simplicibus paniculatisve.

One species of this genus has long been known, and was described, above sixty years since, by Vahl, under the name of *Schotia simplicifolia*, which it has retained in all systematic works, without, however, having ever been reexamined, and with frequent doubts expressed as to its being rightly placed. The flowers have, it is true, individually, a general resemblance to those of a Schotia, but their structure, as well as the general habit of the plant, are much nearer to those of a Bauhinia. I had, indeed, some doubts whether it ought to be regarded as more than a section of that genus; for although the leaves have no tendency to the two lobes characteristic of the greater number of Bauhinias, nor have they even the three strong veins of the few entire-leaved species of that genus, yet there are generally, besides the midrib, a faint lateral one on each side, showing no absolute departure from the foliage of the tribe. The long-stalked short pod, however, with a remarkably hooked style, and the apparent difference in the foliage may be a sufficient warrant to adopt the genus as proposed by Welwitsch. He has dedicated it to the truly noble and enlightened Viscount Sa de Bandeira, recently raised to the dignity of Marquess de Bandeira, to whose exertions and patronage as Portuguese Minister of Marine Dr. Welwitsch mainly ascribes his having been able successfully to accomplish his arduous expedition into tropical Africa.

Our collections evidently contain two distinct species, which may be characterized as follows:—

1. B. speciosa, Welw. MS. (Plate XL.) Foliis plerisque 3–5-nerviis, racemis tenuissime canescentibus, legumine stipite suo multo longiore oblique oblongo antice stylo recto mucronato.

Frutex ex Welwitschio scandens, nunc arbuscula, ramulis novellis canescentibus, adultis glabris. Folia breviter petiolata, ovali-elliptica, obtusa v. breviter obtuseque acuminata, 2–4 poll. longa, tenuiter coriacea, glabra, nitida, pennivenia et reticulato-venulosa, et nervis lateralibus utrinque 1–2 e basi oriundis costa media multo tenuioribus brevioribusque percursa. Racemi tomento tenuissimo canescentes, breves, densiflori, in paniculam terminalem foliatam dispositi. Flores nutantes, atropurpurei, primo

intuitu *Fuchsias* mentientes. Pedicelli 2–3 lin. longi. Bracteæ et bracteolæ minutæ, caducæ. Calyx tomento minuto canescens; tubus discifer ad 9 lin. longus, crassiusculus, basi oblique obtusus, apice dilatatus in limbum late campanulatum 3–4 lin. latum abiens; lobi breves, lati. Petala oblongo-linearia, exserta, stipitata, lamina 3–4 lin. longa. Stamina petalis parum longiora. Ovarium longe stipitatum, oblique acutum. Legumen valde obliquum, oblongum, in speciminibus suppetentibus 2 poll. longum 1 poll. latum, stipite 9 lin. longo, apice basique obtusissimum sed stipiti dorso supra basin affixum et antice infra apicem stylo brevi recto mucronatum.

Hab. West tropical Africa, in bushy palm-grounds near Bango, district of Golungo Alto, in Angola (*Welwitsch*); and if, as is probable, this be the *Schotia simplicifolia*, Vahl in DC. Prod. xi. 508, and Schum. et Thonn. Beskr. Guin. Pl. 212, it was also found by Thonning in the neighbourhood of Christiansberg and in Aguapim on the Guinea coast.

2. B. TENUIFLORA, Benth. Foliis obscure trinerviis, racemis glabris, legumine stipite suo subbreviore antice stylo inflexo mucronato.

Frutex alte scandens, undique glaber. Folia subsessilia, ovali-elliptica v. oblonga, acuminata v. obtusa, 2–4 v. rarius 5 poll. longa, coriacea, nitida, pennivenia, nonnunquam nervis lateralibus prope marginem a basi ortis sed sæpius tenuissimis percursa. Racemi terminales, speciosi, coccinei, densiflori. Calyces pollicares v. paullo longiores, glabri, tubo discifero quam in *B. speciosa* tenuiore, limbo latiore. Petala etiam latiora, 5–6 lin. longa, subsessilia. Legumen 6–9 lin. longum, 4–5 lin. latum, basi subæquale, apice rotundatum, stylo inflexo antice uncinatum, stipite gracili 8–10 lin. longo.

Hab. West tropical Africa, island of Fernando Po (*G. Mann*).

XII. MACROLOBIUM, Schreb.; Benth. et Hook. f. Gen. Pl. 579.

(Tribe AMHERSTIEÆ. Tropical America and Africa.)

The two Aubletian genera *Vouapa* and *Outea* had long since been united under Schreber's name *Macrolobium*, adopted by De Candolle; but, at the time of working up Schomburgk's Guiana Leguminosæ for Hooker's 'Journal of Botany' (vol. ii. p. 95), it appeared to me, from the materials we then possessed, that the bifoliolate Vouapas might always be distinguished from the pinnate-leaved Outeas by the pod, and that both differed from the African Anthonothas, in their simple inflorescence at least, if not in the pod also. Now, however, the accession of several American as well as African species shows that these differences are by no means constant: there is considerable diversity in the pods of different species in both the American groups; and one American species, *M. limbatum*, Spruce[*], has precisely the inflorescence previously supposed to be characteristic of the African ones. The latter may, however, still be retained as a section, distinguished by the pinnate leaves, larger and less oblique than in most of the American ones, and more or less silky underneath with exceedingly minute hairs, whilst the American are

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[*] *M. limbatum*, foliolis 2 longe oblongis glabris, venis primariis in costam intramarginalem confluentibus, racemis brevissimis secus ramos dense fasciculato-paniculatis, calycis tubo discifero turbinato, petalo summo longe unguiculato, lateralibus 2 minutis, staminodiis 0.—Foliola 6–8-pollicaria v. longiora, petiolo communi brevissimo. Paniculæ ad nodos vetustos 1–1½-pollicares. Flores parvuli, filamentis 3 antheriferis longis gracilibus.—Sandy woods or Caatingas on the Rio Uaupés (*R. Spruce*), n. 2668.

quite glabrous—and by a more coriaceous, usually tomentose or canescent pod, and more prominently marked with obliquely transverse wrinkles.

The following are the three African species known to me:—

1. M. STIPULACEUM, foliolis 3–4-jugis oblongis cuspidatis, stipulis maximis foliaceis persistentibus, racemis secus ramos dense fasciculato-paniculatis, calycis tubo discifero parvo campanulato, petalo summo longiuscule unguiculato, lateralibus 4 parvis squamiformibus, staminodiis paucis parvis.

Arbor parva, ramulis petiolis inflorescentiaque pilis minutis appressis tenuiter tomentellis. Foliola sæpe 6–10 poll. longa, jugi infimi minora, utrinque rotundata v. angustata, in acumen angustum $\frac{1}{4}$–$\frac{1}{2}$-pollicare producta, supra glabra, subtus tenuiter sericea v. cano-nitentia. Stipulæ lato-lanceolatæ, acutæ, erectæ, rigidulæ, 1–2-pollicares. Paniculæ rameales dense cymiformes, sæpe 2–3 lin. latæ. Flores quam in cæteris speciebus multo majores. Bracteæ subpersistentes, concavæ, 1–2 lin. longæ. Pedicelli semipollicares. Bracteolæ obovatæ, 5–6 lin. longæ, in siccis striatulæ. Calyx glaber, tubo vix lineam excedente; lobi 4, late ovati, obtusi, petaloidei. Petalum superius 4–5 lin. latum, ungue vix 3 lin. excedente; lateralia $\frac{1}{2}$ lin. longa. Stamina 3, longiuscule exserta. Ovarium dense villosum, stipite brevissimo hinc adnato; stylus elongatus, stigmate subcapitato. Ovula 6–8. Legumen ignotum.

Hab. West tropical Africa, on the Gaboon river (*G. Mann*).

2. M. PALISOTI, foliolis 2–3-jugis obovali-oblongis ellipticisve acuminatis, stipulis obsoletis, racemis brevibus laxiusculis secus ramos fasciculato-paniculatis, calycis tubo discifero brevissimo, petalo summo longiuscule unguiculato, lateralibus 2 parvis, additis interdum 2 infimis minutis, staminodiis nonnullis elongatis.

Anthonotha macrophylla, Pal. Beauv. Fl. Ow. et Ben. i. 71, t. 42.

Hab. West tropical Africa. Senegambia (*Heudelot*, n. 793). Fernando Po (*G. Mann*). Confluence of the Quorra and Tchadda (*C. Barter*). District of Golungo Alto (*Welwitsch*).

This appears to have a wide range, and to be somewhat variable in aspect; I had, indeed, at first considered the Fernando-Po specimens to form a distinct species, with the leaves more glabrous underneath and larger; but a further examination convinces me that all the specimens, from the south as well as north of the equator, belong to one species. The staminodia are certainly variable in number and size; and occasionally one or two of the longer ones may become perfect stamens, but much smaller than the three long stamens. The colour of the petals, however, is, according to Mann, yellow: in the Fernando-Po tree they are pink in the figure of the 'Flore d'Oware et de Benin;' but as most of the plates there are coloured after the artist's fancy, this requires further investigation.

3. M. HEUDELOTII, Planch. in herb. Hook. sub *Anthonotha.* Foliolis 2–3-jugis ovatis ellipticisve, stipulis obsoletis, racemis brevissimis secus ramos elongatos aphyllos racemiformes fasciculatis, petalo summo breviter unguiculato, 2 lateralibus sessilibus summo parum brevioribus, 2 infimis minutis, staminodiis 0 (rarisve).

Frutex elatus, ex Heudelotio 4–5-metralis (12–15-pedalis). Foliola in speciminibus 2–4-pollicaria, breviter acuminata, glabra v. vix subtus minutissime sericea. Paniculæ racemiformes, terminales, pedales et ultra, graciles, minute sericeæ; florum fasciculi parvi, densi, sessiles v. breviter pedunculati. Bracteæ

inconspicuæ. Pedicelli 2–3 lin. longi. Flores quam in *M. macrophyllo* minores, ex Heudelotio rubri. Bracteolæ obovatæ, concavæ, 2½ lin. longæ. Calycis tubus brevissimus; lobi petaloidei, bracteolas vix superantes, summo latiore bifido. Petala 3 lata, bifida, calycem subæquantia, intermedio intimo paullo longiore et breviter unguiculato, lateralibus sessilibus latis, 2 infima minute squamiformia, vix ½ lin. longa. Staminodia nulla detexi. Legumen ut in specie præcedente 2–4-pollicare, obliquum, latum, crasse coriaceum, tomentosum v. villosum, oblique rugosum, sutura superiore dilatata utrinque elevato-marginata.

Hab. West tropical Africa. Dry situations in the Fouta Dhiallon in Senegambia (*Heudelot*, n. 738). The very short claw of the upper inner petal is an exception in the genus which was unknown to me when I drew up the character for the 'Genera Plantarum.'

XIII. BERLINIA, Soland.; Benth. et Hook. f. Gen. Pl. 579.

The number of species of this beautiful genus has now been raised by our African collectors to six, of which the following are the diagnostic characters:—

1. B. **BRACTEOSA**, sp. n. Foliolis 3–4-jugis ample obovato-ellipticis oblongisve tenuiter coriaceis, racemis simplicibus densis ante anthesin lupulinis, bracteis amplis imbricatis alabastra obtegentibus, petalis æquilongis omnibus laminatis summo latissimo.

Arbor fide Mannii 40-pedalis, inflorescentia excepta, glabra. Foliola longiuscule petiolulata, 6–8 poll. longa, obtuse acuminata, pennivenia et reticulato-venulosa; stipulæ parvæ. Racemi terminales, supra folia ultima subsessiles, ineunte inflorescentia densi, demum ultrapedales, rhachi bracteis bracteolisque tomento brevissimo incanis sericeisve. Bracteæ ad basin pedicellorum coriaceæ, cuneato-oblongæ, acuminatæ, concavæ fere naviculares, 2–2½ poll. longæ, primum imbricatæ alabastra obtegentes, per anthesin caducæ. Pedicelli crassi, 6–9 lin. longi. Bracteolæ ad apicem pedicelli cuneato-oblongæ, 2–2½-pollicares, alabastrum valvatim includentes, per anthesin patentes. Calycis tubus discifer angustus, 6–7 lin. longus, fere glaber; limbi segmenta 5, petaloidea, anguste oblongo-linearia v. lanceolata, inter se subæqualia, 1½-pollicaria. Petala 5, æquilonga, ungue lato-lineari, lamina suborbiculata v. transverse latiore emarginata margineque crispa; 4 inferiora, inter se similia, ungue fere 2-pollicari, lamina 1–1¼ poll. lata; summum intimum, ungue breviore, lamina 2 poll. lata. Stamina 10, longiuscule exserta. Ovarium longiuscule stipitatum, tomentellum, 5–6-ovulatum.

Hab. West tropical Africa. Island of Fernando Po (*G. Mann*).

2. B. **ACUMINATA**, Soland. in Hook. f. Fl. Nigr. 326. Foliolis 3–5-jugis obovali-ellipticis oblongisve tenuiter coriaceis, racemis brevibus subcorymbosis, bracteis parvis caducissimis, petalo summo maximo ungue bracteolas vix superante, inferioribus parvis angustis.

Arbor 40–60-pedalis. Foliola 4–8-pollicaria, acumine vario, sæpius brevi. Flores albi, in speciminibus Mannianis maximi, bracteolis 2-pollicaribus basi longe angustatis, petalo summo 2½ poll. lato; in Heudelotianis flores conspicue minores, bracteolis vix 1½ poll. longis, petalo summo ut videtur latitudine pollicem paullo excedente; petala inferiora segmentis calycinis breviora v. vix longiora. Stamina 10, longe exserta. Legumen planum, pedale, 2 poll. latum.

Hab. West tropical Africa. Bassa Cove (*Ansell*); Cameroon river (*G. Mann*); Old Calabar river (*G. Mann, Rev. W. G. Thomson*); and the smaller variety on the Upper Pongos river, Senegambia (*Heudelot*).

3. B. **AURICULATA**, sp. n. Foliolis 2–3-jugis obovali-oblongis ellipticisve tenuiter coriaceis, racemis brevibus subcorymbosis, bracteis parvis caducissimis, petali summi ungue bracteolis 2–3-plo longiore supra basin auriculato, lamina bifida, inferioribus parvis.

Arbor 20–30-pedalis. Foliola longiuscule petiolulata, fere *B. acuminatæ*, sed sæpe basi inæquilatera, pleraque 4–6-pollicaria. Stipulæ inconspicuæ. Racemi ad apices ramorum conferti, rhachibus vix tomentellis 1–2-pollicaribus. Pedicelli 4–6 lin. longi. Bracteolæ obovatæ, concavæ, 8–9 lin. longæ, basi valde contractæ et ima basi diu connatæ. Calyx glaber, tubo angusto 3 lin. longo, segmentis linearibus v. lineari-lanceolatis petaloideis 5–6 lin. longis. Petali summi unguis subpollicaris, utrinque supra basin auricula latiuscula obtusa auctus, lamina ad pollicem lata; petala inferiora calycis segmentis breviora, supra basin dilatata, acute acuminata, omnia æqualia v. 2 infima multo minora. Stamina 10, longe exserta. Ovarium brevissime stipitatum.

Hab. West tropical Africa. Cameroon river (*G. Mann*).

4. B. STIPULACEA, sp. n. Foliolis 3–5-jugis anguste oblongis rigide coriaceis, stipulis longis rigidis persistentibus, racemis subcorymbosis, bracteis parvis caducissimis, petali summi ungue tenui bracteolis longiore lamina late bifida, inferioribus minimis, staminibus 5.

Arbor 20–30-pedalis, inflorescentia excepta, glabra. Foliola quam in cæteris speciebus angustiora et rigidiora, secus rhachin fere sessilia, 4–5-pollicaria, brevissime acuminata v. calloso-mucronata, pennivenia et reticulato-venulosa, nitidula. Stipulæ rigidæ, late lanceolatæ, multinerves, sæpius vix poll. longæ. Racemi in paniculam breviter corymbosam dispositi, rhachi 1–2-pollicari cum bracteolis tomento brevi ferruginea. Bracteæ late ovatæ v. orbiculatæ, pedicello multo breviores et ante anthesin deciduæ. Pedicelli ½–1-pollicares. Bracteolæ obovato-oblongæ, concavæ, pollicares v. paullo longiores, basi quam in præcedentibus minus contractæ. Calycis tubus discifer vix 2 lin. longus, late turbinatus; segmenta angustata, 3–4 lin. longa. Petali summi unguis angustus, inappendiculatus, circa 15 lin. longus, lamina 1½ poll. lata, profunde bifida; petala 4 inferiora minima, linearia. Stamina 5, longe exserta. Ovarium villosum, brevissime stipitatum.

Hab. West tropical Africa. On the river Muni, lat. 1° N. (*G. Mann*).

5. B. ANGOLENSIS, Welw., sp. n. Foliolis 3–4-jugis ovalibus v. ovali-oblongis tenuiter coriaceis, racemis subcorymbosis, bracteis parvis caducissimis, petalis subæquilongis, 4 subsessilibus, summo evidentius stipitato, staminibus 10.

Arbor mediocris, inflorescentia excepta, glabra v. foliis novellis tenuiter canescentibus. Foliola in speciminibus 4–8-pollicaria, nunc latiuscula et obtusissima v. retusa, nunc angustiora acuminataque, petiolulo brevi rigidulo; in ramulis sterilibus foliola interdum fide Welwitschii ultrapedalia. Racemi breves, conferti, paniculam corymbosam v. rarius oblongam foliis ultimis multo breviorem efficientes, rhachi bracteolisque sericeo-tomentosis. Bracteæ parvæ, latæ, longe ante anthesin deciduæ. Pedicelli vix 2 lin. longi. Bracteolæ obovali-oblongæ, concavæ, 6–7 lin. longæ, per anthesin patentes. Calycis tubus discifer angustus, 3–4 lin. longus, glaber; limbi segmenta petaloidea, lineari-lanceolata, acutiuscula, 4–5 lin. longa. Petalum summum intimum breviter unguiculatum, ovatum, cucullato-complicatum, 6–7 lin. longum; lateralia 4 sessilia, oblique ovali-oblonga, plana v. vix margine undulata. Stamina 10, longiuscule exserta, filamentis basi glabris pilosulisve. Ovarium villosissimum, stipite brevi; ovula 5–6. Legumen planum, crasso-coriaceum, oblique rugosum, ¾-pedale.

Hab. West tropical Africa. In the woods of Mata do Mangue, and on the river Cuanza, in the province of Pungo Andongo (*Welwitsch*).

The flowers, so much smaller than those of any of the preceding Berlinias, would appear to connect this species with *Macrolobium*; but their structure is entirely that of *Berlinia*.

6. B. PANICULATA, sp. n. Foliolis 2–4-jugis ovali-oblongis basi inæquilateris coriaceis canescenti-tomentosis glabratisve, racemis brevibus paniculatis, bracteis parvis caducis, petalis subæquilongis, 4 spathulatis, summo breviter stipitato, staminibus 10 basi diadelphis.

Arbor mediocris, late comosa, 30 pedes attingens, sed jam statu juvenili 5–6 pedes alta frequenter florens. Ramuli foliaque novella tomento brevi molli canescentia, adulta sæpe glabrata. Foliola 2–4-pollicaria, obtusissima v. breviter obtuseque acuminata, rigidule coriacea, petiolulo 1–2 lin. longo, lamina tamen latere inferiore fere ad basin petioluli decurrente. Stipulæ parvæ, latæ, rigidæ. Racemi breves densique, in paniculam ramosam folia superiora sæpe æquantem dispositi, rhachi bracteis bracteolisque fulvo-tomentosis, floribus ex albido flavescentibus. Bracteæ orbiculatæ, concavæ, 1–2 lin. latæ. Pedicelli vix unquam 1 lin. longi. Bracteolæ suborbiculatæ, concavæ, 6–7 lin. longæ, alabastra includentes, per anthesin patentes. Calycis tubus discifer brevissime turbinatus, vix 1 lin. longus; limbi segmenta 5, rigidule petaloidea, margine ciliata, obovali-oblonga, 2–3 lin. longa. Petala 4 inferiora spathulata, 4–5 lin. longa, lamina 1–2 lin. lata, 2 infima lateralibus paullo minora; quintum summum interius breviter unguiculatum, late ovato-suborbiculatum, concavum, cæteris paullo brevius. Stamina 10, longiuscule exserta, 9 inferiora basi in vaginam fere 2 lin. longam connata, decimum summum a basi liberum. Ovarium brevissime stipitatum, breve, villosissimum, ovulis 4–5; stylus elongatus, glaber, involutus, stigmate peltato. Legumen oblongum, valde obliquum, 2–3 poll. longum, 1–1¼ poll. latum, junius dense tomentosum, demum glabratum, læve nec rugosum.

Hab. West tropical Africa. Angola district, forming with other Leguminous trees considerable woods in the district of Huilla, and, judging from a specimen in fruit only, also in Pungo Andongo (*Welwitsch*).

This species, in its small flowers, short calyx-tube, and reduced petals, forms some approach to the genus *Brachystegia*, and differs from that, as well as from the true Berlinias, in the stamens diadelphous at the base; but this character does not appear to be of sufficient importance for its separation from the latter genus, with which it is closely connected through *B. angolensis*.

Var.? *ferruginea*, foliis molliter fulvo-villosis. Rare near Mumpulla in the Huilla district (*Welwitsch*).

The specimen is in fruit only, but appears to differ from the normal form only in the indumentum.

XIV. BRACHYSTEGIA, Benth. in Benth. et Hook. f. Gen. Pl. 582.

(Tribe AMHERSTIEÆ. Tropical Africa.)

CHAR. GEN. Calycis tubus discifer brevissimus v. subnullus; limbi segmenta 2–5, parva, petaloidea v. minute squamiformia. Petala 0 vel rarius 1–2 minutissima. Stamina 10, subdeclinata, basi breviter connata v. sublibera, filamentis elongatis; antheræ ovato-oblongæ, loculis longitudinaliter dehiscentibus. Ovarium stipitatum v. subsessile, liberum, breve, ∞-ovulatum; stylus elongatus, stigmate terminali truncato v. dilatato. Legumen oblongum v. lato-lineare, obliquum v. falcatum, compressum, coriaceum v. sublignosum, 2-valve, sutura superiore incrassata. Semina pauca, transversa, ovata vel orbiculata, compressa; albumen 0; cotyledones planæ, carnosulæ, radicula brevi recta inclusa.—Arbores cortice fibroso. Folia abrupte pinnata, foliolis haud amplis sæpius obliquis. Flores parvuli, in racemos breves densos nunc simplices spiciformes, nunc plurimos paniculatos dispositi. Bracteæ caducissimæ; bracteolæ obovato-orbiculatæ, concavæ, alabastrum bivalvatim includentes calycemque mentientes, per anthesin patentes.

The above character is slightly modified from that which we had given in the 'Genera Plantarum,' the additional species received from Dr. Welwitsch since the sheet was printed off having enabled me more correctly to understand the structure of the flowers. The calyx-like outer envelope is in fact, as we had doubtfully suggested, a pair of bracteoles like those of *Macrolobium* and *Berlinia*; the very small scale-like bodies described as petals are shown by the *B. tamarindoides*, in which they are more developed, to be calyx-segments, like those of *Berlinia*, five in number when complete, but some often deficient; and the petals appear to be entirely wanting, or reduced to one or two quite microscopic. The genus may be considered, therefore, to be much more closely allied to *Berlinia* than we had supposed, chiefly in the very much reduced floral envelopes.

Of this genus we have now the three following species:—

1. B. TAMARINDOIDES, Welw. Foliolis 10–20-jugis oblique oblongo-lanceolatis obtusis sessilibus basi valde inæquilateris, racemis brevibus densis paniculatis, pedicellis brevissimis, ovario subsessili.

Arbor ex Welwitschio 20–40-pedalis, habitu et imprimis foliorum figura et compositione *Tamarindo indicæ* simillima. Ramuli et folia novella tomentoso-puberula, adulta glabrata. Foliola arcte sessilia, conferta, 6–9 lin. longa, obtusa, basi latere interiore angusta, exteriore rotundata, coriacea, 2–3-nervia, costa media parum excentrica. Inflorescentia fulvo-tomentosa; racemuli fere in spicas parvas oblongas v. subglobosas conferti, in paniculam oblongam folia summa non excedentem dispositi. Bracteæ ovatæ, concavæ, 1–1½ lin. longæ, caducæ. Pedicelli vix ulli. Bracteæ ovali-orbiculatæ, concavæ, 2½ lin. longæ. Calycis segmenta 5, squamiformia, ciliata, vix lineam longa. Petala 0 vel rarius 1–2, minuta, linearia. Stamina 10, bracteolis paullo longiora, basi in annulum brevissime connata. Ovarium subsessile, villosum, 6–8-ovulatum. Stylus glabratus, stigmate truncato. Legumen valde obliquum, in stipite brevissimo angulo recto inflexum, 2–3 poll. longum, planum, crasso-coriaceum, læve, sutura superiore incrassato-dilatata.

Hab. West tropical Africa. In the Huilla district of Angola, forming here and there small woods between Lopollo and Lake Toantâla (*Welwitsch*).

Dr. Welwitsch has also specimens of two trees which, if not varieties, appear to be closely allied to the preceding,—one, in leaf and fruit, with the leaflets of the same number and shape as in *B. tamarindoides*, but nearly twice as large, and not crowded, and the pod larger and not so smooth. This was gathered by Welwitsch between Condo and Guisonde, and at Sansamanda in Pungo Andongo. A single leaf of a tree from the mountains of Zanguebar in Speke and Grant's collection belongs probably to the same species or variety. The other is more evidently distinct, but is in leaf only: the leaflets are more numerous, intermediate in size between those of the two others, and the midrib is very near to the upper margin. It forms a low shrub of 1 to 2½ feet, common in the Mutollo woods between Pedras de Guinga and Candumba in the district of Pungo Andongo.

2. B. SPICÆFORMIS. Foliolis 4–6-jugis ovatis vel ovali-oblongis obtusis basi obliquis brevissime petiolulatis, racemis brevibus simplicibus dense spiciformibus, pedicellis brevissimis, ovario breviter stipitato.

Arbor gracilis, 10–20-pedalis, ramulis foliisque novellis pube brevi plus minus vestitis demum glabriusculis. Foliola per paria dissita, 1–1½ vel rarius 2 poll. longa, basi oblique rotundata, tenuiter coriacea, pennivenia, costa parum excentrica, petiolulo brevissimo at distincto. Stipulæ lineares,

membranaceæ, caducissimæ. Spicæ fulvo-pubescentes, novellæ cylindricæ bracteis alabastrisque imbricatis, per anthesin oblongæ, rhachi demum 1–1½-pollicari. Bracteæ, orbiculatæ, concavæ, 2 lin. longæ, caducissimæ. Pedicelli vix ulli. Bracteolæ obovato-orbiculatæ, concavæ, 3–4 lin. longæ, per anthesin patentes. Calycis segmenta squamiformia 1–5, sæpius 2, inæqualia, oblonga v. linearia, rarissime lineam excedentia. Petala sæpius 0, rarissime adsunt 1–2 minuta. Stamina 10, breviter exserta, basi in cupulam brevem irregulariter connata. Ovarium breviter stipitatum, dense villosum, ovulis ad 6; stylus glaber, stigmate truncato. Legumen 3–4 poll. longum, 1¼–1½ poll. latum, coriaceo-sublignosum, læve, sutura superiore incrassato-dilatata.

Hab. Tropical Africa. In woods of the Huilla district of Angola, rather frequent between Mumpulla and Nene, and between Morino and Lake Tvantala (*Welwitsch*).

Var. *parviflora.* Bracteoles scarcely 3 lines long, but every other character precisely as in the western specimens. Robeho mountains, in Zanguebar, at an elevation of 4700 feet (*Speke and Grant*, who observe that the bark is made into kilts, cloths, band-boxes, huge grain-stores, mats, roofing for camp-huts, &c., and that a blood-red juice exudes on cutting the bark).

Var. (?) *grandiflora.* Bracteoles rather above 4 lines long, and flowers not quite so sessile, but otherwise the same. Summits of the Sierra da Hella in the Huilla district, at an elevation of 4000 feet, with flowers and young leaves at the ends of the branches, otherwise nearly leafless (*Welwitsch*).

3. B. APPENDICULATA. (Plate XLII.) Foliolis 3–6-jugis ovali-oblongis lanceolatisve vix coriaceis glabris breviter petiolatis, racemis confertis subramosis, pedicellis bracteolis subæquilongis, ovario longe stipitato.

Arbor 20–40-pedalis, inflorescentia excepta, glabra; foliola secus petiolum tenuem per paria dissita, 1–2-pollicaria, acuminata v. obtusa, obliqua, falcata v. basi inæquilatera v. rarius subæqualia, multo tenuiora quam in speciebus præcedentibus, pennivenia et venulosa. Stipulas non vidi. Glandulæ parvæ vesiciformes ad basin foliolorum sæpe stipellas mentientes. Racemi dense multiflori, oblongi, breviter pedunculati, 1–2-pollicares, solitarii simplicesque v. basi ramo uno alterove instructi. Bracteæ minimæ, lineares, caducissimæ. Pedicelli graciles, ad 3 lin. longi. Bracteolæ 2–2½ lin. longæ, late obovatæ, concavæ, extus tomentellæ, per anthesin patentes. Calycis segmenta squamiformia sæpius 2–3. Petala nulla invenimus. Stamina 10, bracteolis dimidio longiora, filamentis gracilibus basi breviter connatis; antheræ glandula minuta apiculatæ. Ovarium longiuscule stipitatum, breve, margine ciliatum, ovulis 5–6. Legumen 3–4 poll. longum, 1¼–1½ poll. latum, sutura superiore incrassato-dilatata.

Hab. East tropical Africa. Highlands of the Batoka Country and about Zomba, on Lake Shirwa, the fibrous bark one of those used for cloth by being beaten out, and the seeds eaten (*Kirk*).

XV. BAIKIÆA, Benth. in Benth. et Hook. f. Gen. Pl. 581.

(Tribe AMHERSTIEÆ. Tropical Africa.)

CHAR. GEN. Calycis tubus discifer turbinatus; segmenta 4, longa, crassa, marginibus abrupte attenuatis anguste imbricatis. Petala 5, unguiculata, obovato-spathulata, subæquilatera, summo intimo subæquilatero, cæteris obliquis. Stamina 10, summo libero, cæteris basi connatis, filamentis alternis basi villosis, alternis tenuioribus glabris; antheræ lineares, versatiles. Ovarium dense villosissimum, ∞-ovulatum, stipite calycis tubo hinc adnato; stylus glaber, elongatus, stigmate parvo. Legumen . . .—Arbores, floribus exceptis, glabræ. Folia abrupte pinnata, foliolis 1–2-jugis coriaceis. Flores maximi, in racemos brevissimos subterminales conferti. Bracteæ et bracteolæ breves, caducæ.

As the flowers of *Camoënsia maxima* are the largest known among Papilionaceæ, so are those of *Baikiæa insignis* the largest among Cæsalpinieæ, and said to be as grand-looking as those of *Camoënsia*. Its characters also, although showing some affinity to *Schotia*, are at the same time so well marked, that there is little danger of the genus being merged into any other. I have therefore great pleasure in dedicating it to the distinguished and enterprising traveller who, during his noble and persevering exertions in the cause of West-tropical-African civilization, has also done so much towards making us acquainted with the botanical treasures of that country, and whose loss every friend of Africa has so much reason to deplore.

The only species known may be thus described :—

B. INSIGNIS, sp. n. (Plate XLI.)

Arbor, teste Mannio, 30–40-pedalis, inflorescentia excepta, glabra. Foliola nunc semipedalia late ovali-elliptica, nunc oblonga 4–5-pollicaria, obtusa v. obtuse acuminata, rigide coriacea, nitida, venis præter costam validam parum conspicuis, petiolulata, secus petiolum brevem opposita v. alterna. Stipulæ parvæ, ovatæ, squamiformes. Flores maximi, nutantes, pauci ad apices ramorum conferti racemum brevissimum constituentes, rhachi bracteis calycibusque dense fusco-velutinis. Bracteæ et bracteolæ latæ, concavæ, 1–2 lin. longæ. Pedicelli brevissimi, crassi. Calycis tubus crassus, turbinatus, fere 9 lin. longus; segmenta linearia, demum 3 poll. longa, crassa, dorso fusco-velutina, intus sericeo-villosa, ad margines angustissime attenuata, per anthesin revoluta et mox decidua. Petala semipedalia, obovata, basi in unguem longe angustata, dorso laxe villosa, intus medio pilosula, marginibus utrinque glabris; summum intimum, cæteris latius at non longius. Stamina 5 petalis fere æquilonga, 5 alterna triente breviora, filamentis basi villosis superne sparse pilosis glabratisve. Ovarium villosissimum, in stipitem longiusculum attenuatum, ovulis ad 8; stylus superne glaber, stigmate capitato.

Hab. West tropical Africa. Island of Fernando Po (*G. Mann*). Some fragments sent from Ango by Consul *Burton* may possibly belong to the same species.

XVI. CRUDIA, Schreb.; Benth. et Hook. f. Gen. Pl. 584.

This genus, hitherto supposed to be exclusively American, had not been recognized in the Old-World species published, which have, consequently, been referred to other genera. The three I am acquainted with are the following :—

1. C. SENEGALENSIS, Planch. in herb. Hook. MS. Glabra, foliolis 5–7 ovatis oblongisve acuminatis basi valde obliquis, stipulis maximis foliaceis persistentibus, racemis laxis pedunculatis.

Frutex elatus v. arbor parva, *C. Parivoæ*, DC., stipulis exceptis, simillima. Foliola 3–4-pollicaria. Stipulæ ovato-lanceolatæ, acutæ, membranaceæ, persistentes, ¾–1 poll. longæ. Racemi 4–5-pollicares. Pedicelli graciles, dissiti. Flores omnino *C. Parivoæ*.

Hab. West tropical Africa. On the Nunez river, Senegambia (*Heudelot*, n. 708). On the Nun river and in the island of Fernando Po (*G. Mann*).

2. C. ZEYLANICA. Glabra, foliolis 2–6 ovatis oblongisve acuminatis basi parum obliquis, stipulis obsoletis, racemis floribundis parce pilosulis folio æquilongis brevioribusve.

Detarium zeylanicum, Thwaites, Enum. Ceyl. Pl. 414.

Arbor ingens; folia fere *C. Parivoæ*. Flores multo minores, pedicellis brevibus.

Hab. Galpatta, near Caltura, Ceylon (*Thwaites*, n. 3714).

3. C. BANTAMENSIS. Foliolis 1–3 ample oblongis v. obovali-oblongis obtusis coriaceis glabris, racemis densifloris puberulis folia excedentibus.

Pryona bantamensis, Miq. Fl. Ind. Bat. i. pars 1. 1081.

Touchiroa bantamensis, Hassk. Retzia, i. 202.

Arbor. Foliola 4–8-pollicaria, petiolo communi brevi. Racemi sæpe ultrapedales, fere a basi floribundi, pedicellis brevissimis.

Hab. Bantam province, in Java (*Hasskarl*).

XVII. CRYPTOSEPALUM, Benth. in Benth. et Hook. f. Gen. Pl. 584.

(Tribe CYNOMETREÆ. Tropical Africa.)

CHAR. GEN. Calycis tubus discifer brevissimus; segmenta 4, minuta, squamiformia. Petalum 1, sessile, orbiculatum. Stamina 3, filamentis brevibus; antheræ oblongæ, versatiles, loculis longitudinaliter dehiscentibus. Ovarium breviter stipitatum, liberum, 2-ovulatum; stylus filiformis, stigmate terminali truncato. Legumen . . . . .—Arbuscula. Folia abrupte pinnata. Flores parvi, in racemos breves axillares dispositi. Bracteæ ad basin racemi junioris squamiformes, imbricatæ, mox deciduæ; bracteolæ majusculæ, concavæ, valvatæ, alabastrum includentes.

This genus is founded on a small African tree which Hooker, in the 'Niger Flora,' had from imperfect specimens, referred doubtfully to *Cynometra*, of which it has the inflorescence. We have now, however, excellent flowering specimens which show a structure much more nearly allied to that of *Copaifera*, but differing in several essential points which appear to justify the raising it into a genus distinct from both *Cynometra* and *Copaifera*. The buds, closed before flowering, and opening into concave valves, are as in *Brachystegia*; but the presence of a rudimentary calyx inside shows, without doubt, that the outer covering must be referred to bracteoles. The stamens, which in *Cynometra* have the complete number of ten, and in *Copaifera* have only occasionally one or two of the ten deficient, are here reduced to three; and the petals, five in *Cynometra*, and none in *Copaifera*, are here reduced to one small one. The pod is unknown, but the ovary is entirely that of the *Cynometreæ*.

The following is the only species known:—

C. TETRAPHYLLUM. (Plate XLIII. B.)

Cynometra? tetraphyllum, Hook. f. Fl. Nigr. 329.

Arbuscula glabra v. inflorescentia parce puberula. Gemmæ squamis imbricatis mox deciduis stipatæ. Foliola sæpissime bijuga, oblique ovata, subfalcata, valde inæquilatera, obtusa vel obtuse acuminata, tenuiter venosa, jugi superioris 1–1½ vel in ramulis sterilibus 2 poll. longa, jugi inferioris dimidio breviora, petiolo communi brevi tenui. Flores parvi, roseo-albi, numerosi, in racemulos axillares foliis breviores dispositi. Bracteæ lanceolatæ, membranaceæ, longe ante anthesin deciduæ. Pedicelli graciles, 2–3 lin. longi. Bracteolæ in speciminibus vix 1½ lin. longæ, florem omnino includentes. Calycis tubus vix ¼ lin. longus, lobis adhuc brevioribus. Petalum ½ lin. longum, suborbiculatum. Genitalia bracteolis breviora. Flores tamen vix perfecte evoluti.

Hab. West tropical Africa. Sugar-loaf Mountain, Sierra Leone (*G. Don*, *Barter*). Although the flowers

of Barter's specimens are none of them quite expanded, yet they have every appearance of having attained their full size, the lower ones of the racemes being often partially open, whilst those from still lower down have already fallen away.

XVIII. COPAIFERA, Linn.; Benth. et Hook. f. Gen. Pl. 585.

Two African trees have been published as new genera, which I should be inclined to reduce to *Copaifera*: they differ strikingly from the majority of the American species in their leaves reduced to a single pair of leaflets; but we have one Cuban species, *C. hymenæifolia*, Moric., in which that is the case, besides the doubtful n. 3150 of Blanchet from Brazil, which may not be a congener, being only known in unripe fruit. One of these African genera, *Guibourtia* of Bennett, has every character of *Copaifera*, except that the bracteoles are persistent and about one-fourth the length of the calyx, whilst in all the other species they are very deciduous and often very minute: but I have never found the persistence and size of bracteoles a good generic character, excepting when they valvately enclose the bud, forming as it were an outer calyx. The other genus, *Gorskia* of Bolle, has a thinner pod than other *Copaiferæ*; but in the American species the pod is variable in thickness and quite flat in some, very convex in others; and this, again, appears to me to be a specific, not a generic distinction. A third tropical-African species of true *Copaifera* has the foliage, minute bracteoles, and flat pod of the West-Indian *C. hymenæifolia*; but the seed is almost totally enveloped in a scarlet arillus, which, in the Cuban species, is thick, obliquely truncate, and under the seed, scarcely embracing its base. To these three I provisionally add the widely spread Ironwood tree of Dr. Kirk, which, on account of its remarkable seed with corrugated cotyledons and numerous immersed resinous vesicles, he had proposed as a distinct genus under the name of *Colophospermum*. I have also since received it from Dr. Welwitsch, who had also proposed it as a new genus. Unfortunately the flowers have not been detected by either of these travellers, and there is nothing in the foliage or pod to distinguish it from the thin-podded Copaiferas except the cotyledons; and the corrugated cotyledons observed in *Macrolobium acaciæfolium*, Benth., and not in the other species of the same genus the nearest allied to it, show that that is not to be regarded as a generic character, unless accompanied by floral differences. We must therefore wait till we have seen the flowers to determine whether *Colophospermum* of Kirk is to be adopted as a genus or to merge into *Copaifera*.

The bifoliolate species of *Copaifera* known to me may be thus distinguished:—

1. C. HYMENÆIFOLIA, Moric. Pl. Nouv. Amér. i. t. 1. Foliolis unijugis falcato-ovatis acuminatis penniveniis coriaceis nitidis, floribus pedicellatis, legumine plano coriaceo, arillo crasso sub semine oblique truncato.

Hab. Cuba (*Ramon de la Sagra*); near Monte Verde in eastern Cuba (*Wright*, n. 1189).

2. C. COLEOSPERMA, sp. n.? Foliolis unijugis falcato-ovatis acuminatis penniveniis coriaceis nitidis, floribus pedicellatis, legumine plano coriaceo, arillo coccineo semen involvente.

Hab. East tropical Africa. Highlands of the Batoka country, where it forms a large tree, in some parts planted at least a hundred years ago. The aril, which is red, is used for making a drink, said to be very nourishing, and to have saved the people in the time of famine (*J. Kirk*).

The specimens are in fruit only, but the persistent pedicels show that the inflorescence was the same as that of *C. hymenæifolia*, the foliage and pods are precisely the same, and the doubt occurs whether the difference in the aril is constant, and whether the species are really distinct? If they are identical, how is their coexistence in two such distant countries to be explained? Can the seeds have been carried out to Cuba by the negro slaves? The precise station in Cuba is not given by Ramon de la Sagra; that given by Wright is near a town or settlement.

3. C. GORSKIANA. Foliolis unijugis late falcato-ovatis obtusissimis vel vix acuminatis 3–4-nerviis penniveniis reticulatis coriaceis, floribus subsessilibus, bracteolis minutis caducissimis, legumine plano tenui reticulato, seminibus exarillatis, cotyledonibus planis.

Gorskia conjugata, Bolle, in Peters, Mossamb. Bot. i. 16, f. 3.

Legumen stipitatum, planum, oblique ovato-orbiculatum, reticulato-venosum, ad 1½ poll. longum, 1 poll. latum, juxta styli vestigium breviter angusteque coriaceo-alatum. Semen compressum, ovali-orbiculatum, hilo laterali; cotyledones carnosulæ, planæ, radicula juxta hilum recta, intra cotyledonum emaginaturam retracta.

Hab. East tropical Africa. Near Sena and Tetté (*Peters*); near Tetté, a tree of considerable size, supplying good timber (*Kirk*).

4. C. GUIBOURTIANA. Foliolis unijugis obovato-falcatis obtuse acuminatis 3–5-nerviis penniveniis reticulatis coriaceis, floribus sessilibus, bracteolis persistentibus calycis quartam partem attingentibus, legumine . . . . .

Guibourtia copallifera, Benn. in Journ. Linn. Soc. i. 150.

Flores quam in cæteris speciebus majores.

Hab. West tropical Africa. Near Goderich and Lumley in Sierra Leone, known as the Kobo-tree (*W. K. Daniell*).

5?. C.? (COLOPHOSPERMUM) MOPANE, Kirk, sp. n. (Plate XLIII. A.). Foliolis unijugis falcato-semiovatis obtusis v. obtuse acuminatis 7–9-nerviis reticulatis, (floribus pedicellatis?) legumine plano tenuiter coriaceo obscure reticulato, seminibus exarillatis vesiculis resiniferis farctis, cotyledonibus corrugatis.

Arbor speciosa, habitu *Bauhiniarum*, ligno præstantissimo, resina sanguinea (*Kirk et Welwitsch*), tota glaberrima. Folia fere *Hardwickiæ binatæ*; foliola valde obliqua, fere semicordata, 1½–2½ poll. longa, ¾–1 poll. lata, arcte sessilia, ad apicem petioli ½–¾-pollicaris acumine parvo subfoliaceo terminati. Flores desunt. Legumina ad axillas racemosa, rhachi foliis sæpius breviore, pedicellis 1–3 lin. longis. Legumen vix stipitatum, oblique obovato-falcatum, 1½–2 poll. longum, fere pollicem latum, stylo laterali, sutura superiore brevi angusta, inferiore angustissime 1-alata. Semen magnum, reniforme, testa tenui, hilo laterali; cotyledones insigniter corrugatæ, vesiculis resinosis semiimmersis conspersæ.

Hab. Tropical Africa. Shiramba and Lupata Mountains on the Zambesi (*Kirk*); forming large forests in the rocky hills round the base of the Serra da Xella, near Bumbo in Angola (*Welwitsch*). Collected by both travellers in 1860, but first received from Dr. Kirk.

XIX. CYNOMETRA, Linn.; Benth. et Hook. f. Gen. Pl. 586.

The species now more or less known of this genus are numerous, dispersed over the tropical regions of the New as well as the Old World, and require a careful revision to determine their limits. The following two new ones however, peculiar to Africa, are so distinct in aspect, in their petal-like bracteoles, and in some points of structure, that I have proposed to establish for them a distinct section, under the name of *Hymenostegia*, thus characterized:—

Bracteolæ membranaceæ, petaloideæ, persistentes. Calycis tubus discifer turbinatus. Petala 2 infima minuta. Ovarii stipes tubo calycino hinc adnatus.

The pod is unknown, except from an old detached valve in Welwitsch's collection, which indicates that it is much larger and of a thinner consistence than in the other species.

1. C. FLORIBUNDA, sp. n. Foliolis 4-jugis oblique trapezoideis, racemis laxis floribundis, bracteolis ovatis cordatisve petaloideis, petalis 2 infimis minutis.

Arbor 30-pedalis. Folia adulta glabra, petiolo communi 1½–2-pollicari; foliola sessilia, obtusiuscula, jugi ultimi 1–1½ poll. longa, inferiora minora, coriacea, basi apiceque valde inæquilatera, costa subtus prominente, tenuissime pennivenia. Stipulæ inconspicuæ. Racemi in axillis summis, 2–3-pollicares, paniculam efficiunt pulchram foliatam, rhachi hirtella a basi florifera. Pedicelli 3–4 lin. longi. Bracteolæ infra apicem pedicelli patentes, obtusæ, 3-lin. v. paullo longiores. Calyx glaberrimus; tubus late turbinatus, 1½ lin. longus; limbi segmenta 4, lata, subpetaloidea, per anthesin reflexa, summo latiore. Petala 2 lateralia obovato-oblonga, in unguem angustata, erecta, 3–4 lin. longa; summum intimum, paullo minus et angustius; 2 infima minuta, linearia. Stamina 10, libera, 5 petala superantia, 5 alterna breviora. Ovarium villosissimum, stipite brevi calycis tubo hinc breviter adnato; stylus elongatus, glaber, stigmate vix dilatato.

Hab. West tropical Africa. On the River Mani, lat. 1° N. (*G. Mann*).

2. C. LAXIFLORA, sp. n. Foliolis 1–2-jugis falcato-ovatis acuminatis, racemis longis paucifloris, bracteolis ovato-subcordatis petaloideis, petalis 2 infimis minutis.

Arbor 25–35-pedalis et altior, glabra. Foliola pleraque unijuga, 2–4-pollicaria, basi valde obliqua, per anthesin membranacea, demum coriacea, nitidula, costa prominente, tenuiter pennivenia, addito nonnunquam pari inferiore foliorum multo minorum. Racemi terminales, simplices, pauciflori. Pedicelli graciles, 4–5 lin. longi. Bracteolæ omnino *C. floribundæ*, nisi paullo majores, et florum structura eadem in alabastro apparet, perfecte evolutos non vidi.

Hab. West tropical Africa. District of Golungo Alto (*Welwitsch*).

DESCRIPTION OF THE PLATES.

PLATE XXXIII.

A. *Microcharis tenella*; natural size. Fig. 1. Flower. 2. Standard. 3. One of the wings. 4. Keel. 5. Stamens. 6. Anther. 7. Calyx and pistil. 8. Pod. 9. Seed. All much enlarged.
B. *Microcharis latifolia.*

PLATE XXXIV.

Mastersia Assamica. Fig. 1. Bud. 2. Flower, with the bracteoles. 3. One of the bracteoles. 4. Standard. 5. One of the wings. 6. Keel. 7. Stamens. 8. Pistil: all somewhat enlarged. 9. Portion of one of the valves of the pod, on the inside, showing the seeds; natural size. 10. Seed, enlarged. 11. Seed cut open, showing the embryo; much enlarged. 12, 13. Embryo. 14. Diagram of the flower, including the bracteoles.

PLATE XXXV.

Panurea longifolia. Fig. 1. Flower. 2. Calyx. 3. Standard. 4. One of the wings. 5. One of the keel-petals. 6. Stamens. 7. Anther. 8. Pistil. 9. The same, with the ovary cut open. All much enlarged.

PLATE XXXVI.

Camoënsia maxima. Fig. 1. Calyx cut open, showing the stamens and insertion of the stipes of the ovary. 2. Pod. 3. Seed. 4. Embryo. 5. The same, cut open, showing the radicle.

PLATE XXXVII.

Batesia floribunda. Fig. 1. Bud. 2. Flower expanded. 3. Two of the petals. 4. Stamens and pistil. 5. Two of the stamens. 6. Pistil. 7. Ovary cut open: all somewhat enlarged. 8. Pod. 9. The same, as open when ripe; and 10. Seed: natural size. 11. Seed somewhat enlarged, and cut open, showing the embryo. 12, 13. Embryo. 14. Diagram of the flower without the bracteoles.

PLATE XXXVIII.

Dicymbe corymbosa. Fig. 1. Flower, with the bracteoles removed. 2. One of the bracteoles. 3. One of the sepals, from outside. 4. The same, from inside. 5. One of the petals, from outside. 6. The same, from inside. 7. Two of the stamens. 8. Pistil. 9. Ovary, cut open: all slightly enlarged. 10. Diagram of the flower, including the bracteoles.

PLATE XXXIX.

Oligostemon pictus, Benth. Fig. 1. Bud, showing the first and second sepals. 2. Third sepal. 3. Fourth sepal. 4. One of the three upper petals. 5. One of the two lower petals. 6. Stamens. 7. The treble upper stamen, from outside. 8. Pistil: all more or less enlarged. 9. Young pod; natural size.

PLATE XL.

Bandeiræa speciosa, Welw. Fig. 1. Flower. 2. Calyx, cut open, showing the stamen and insertion of the pistil. 3. One of the petals. 4. Two of the stamens. 5. Ovary, cut open: all more or less enlarged. 6. Pod; natural size. 7. Seed. 8. Seed cut open, showing the embryo. 9. Embryo.

PLATE XLI.

Baikiæa insignis, Benth. Fig. 1. Stamens. 2. Anther. 3. Ovary cut open. 4. Diagram of the flower.

PLATE XLII.

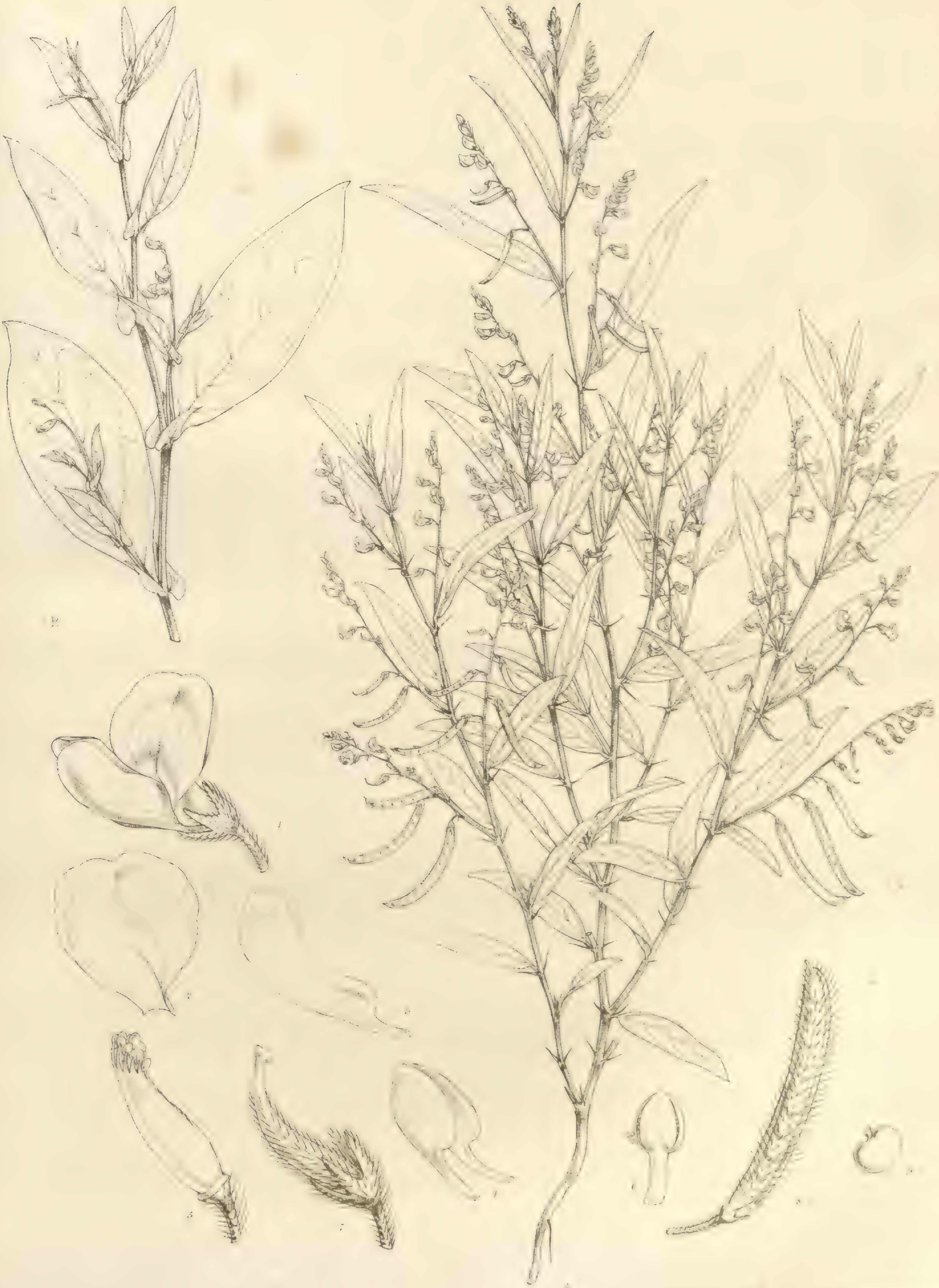
Brachystegia appendiculata, Benth. Fig. 1. Bud, enclosed in the bracteoles. 2. Flower, expanded. 3. One of the calyx-segments or sepals. 4. Ovary, cut open: all much enlarged. 5. Pod; natural size. 6. Seed. 7. Transverse section of the same. 8. Embryo. 9. One of the cotyledons and and radicle. 10. Leaflet, with the stipella-like glands.

PLATE XLIII.

A. *Copaifera Mopane*, Kirk. Fig. 1. Pod, cut open, showing the seed. 2. Seed, cut open, showing a section of the testa, one cotyledon, and the radicle. 3. Transverse section of the seed.

B. *Cryptosepalum tetraphyllum*, Benth. Fig. 1. Bud. 2. Flower, with one of the bracteoles. 3. Petal. 4. Two of the stamens. 5. Calyx and pistil. 6. Ovary, cut open. All much enlarged.

TRANS. LINN. SOC. VOL. XXV. TAB 33.



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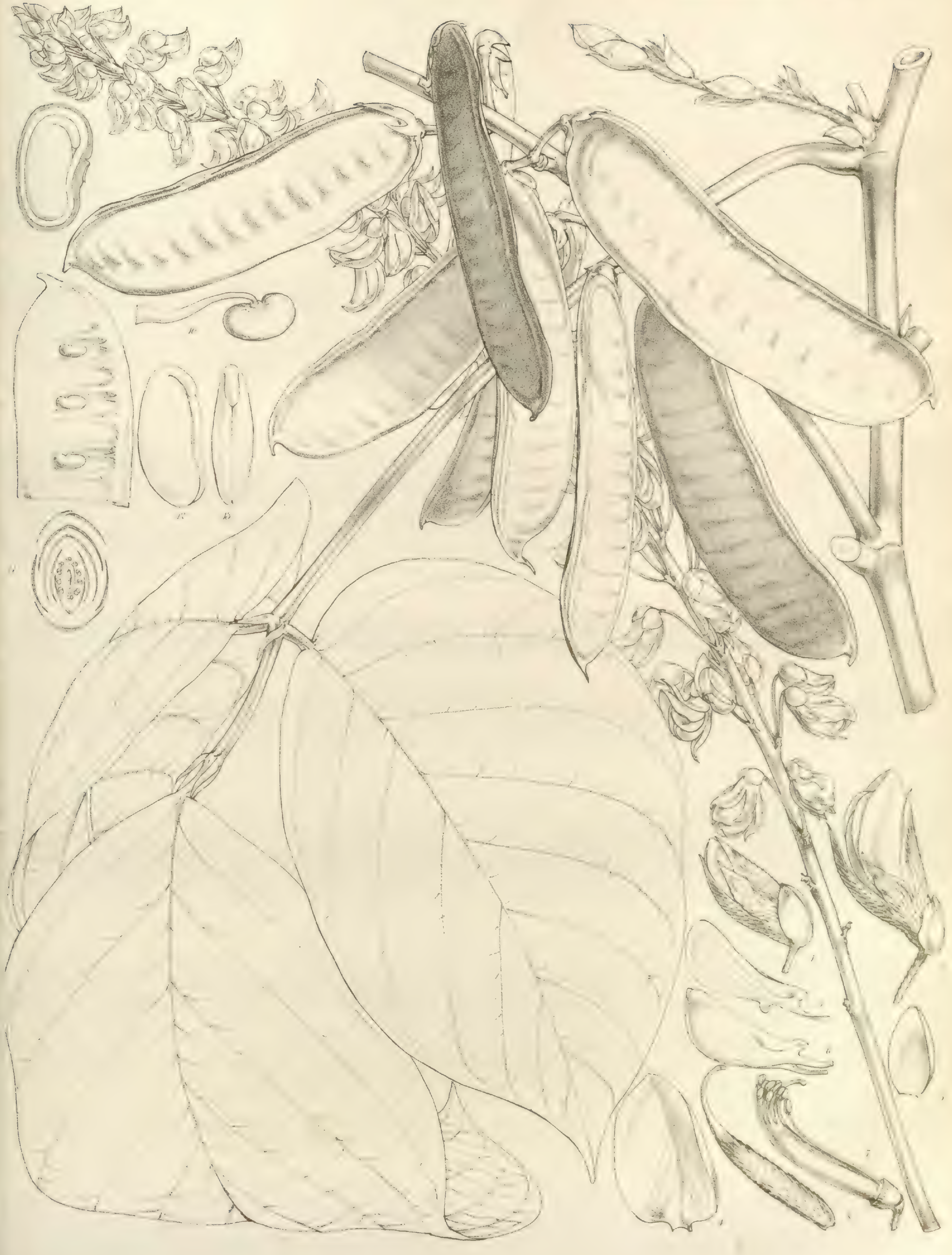
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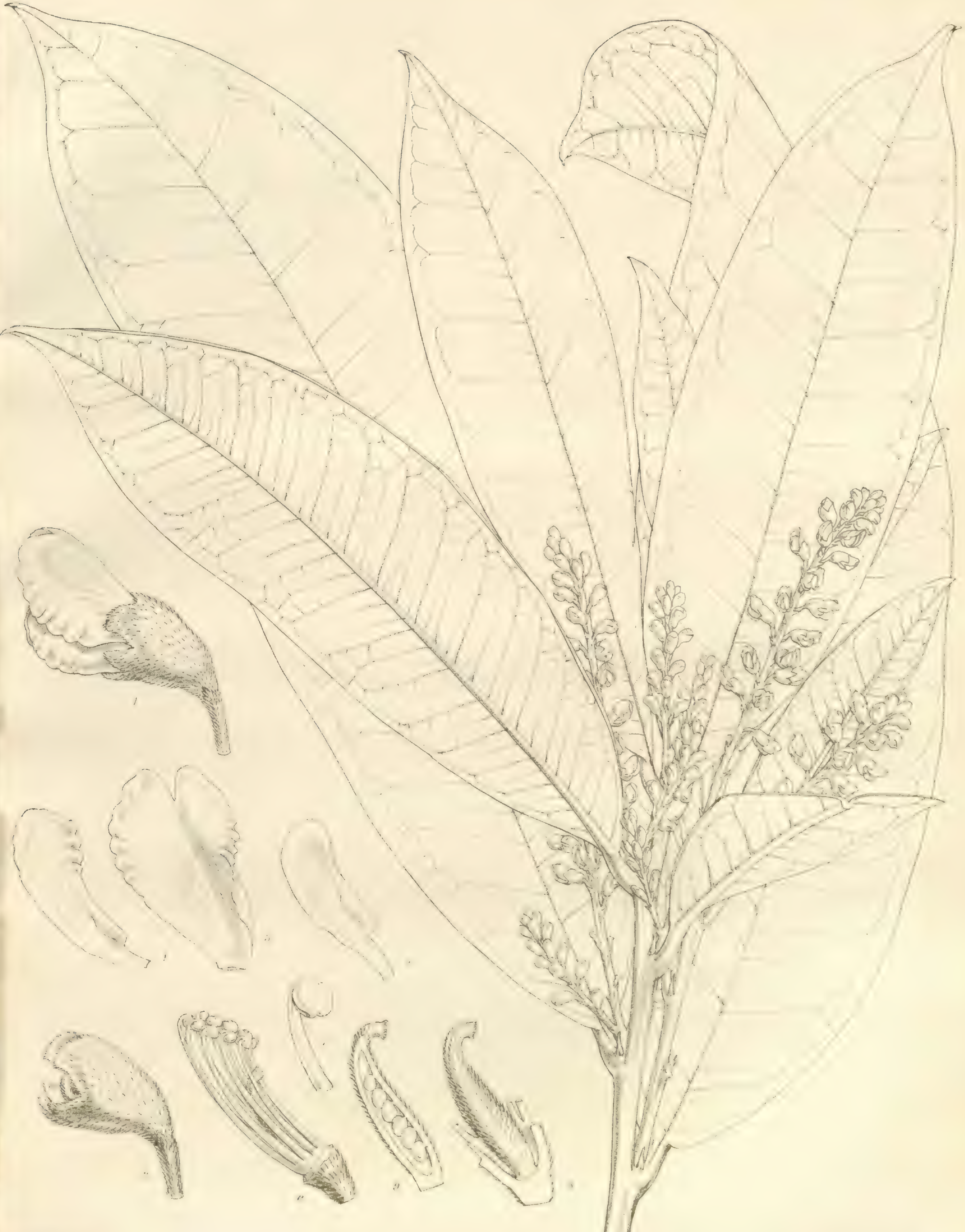

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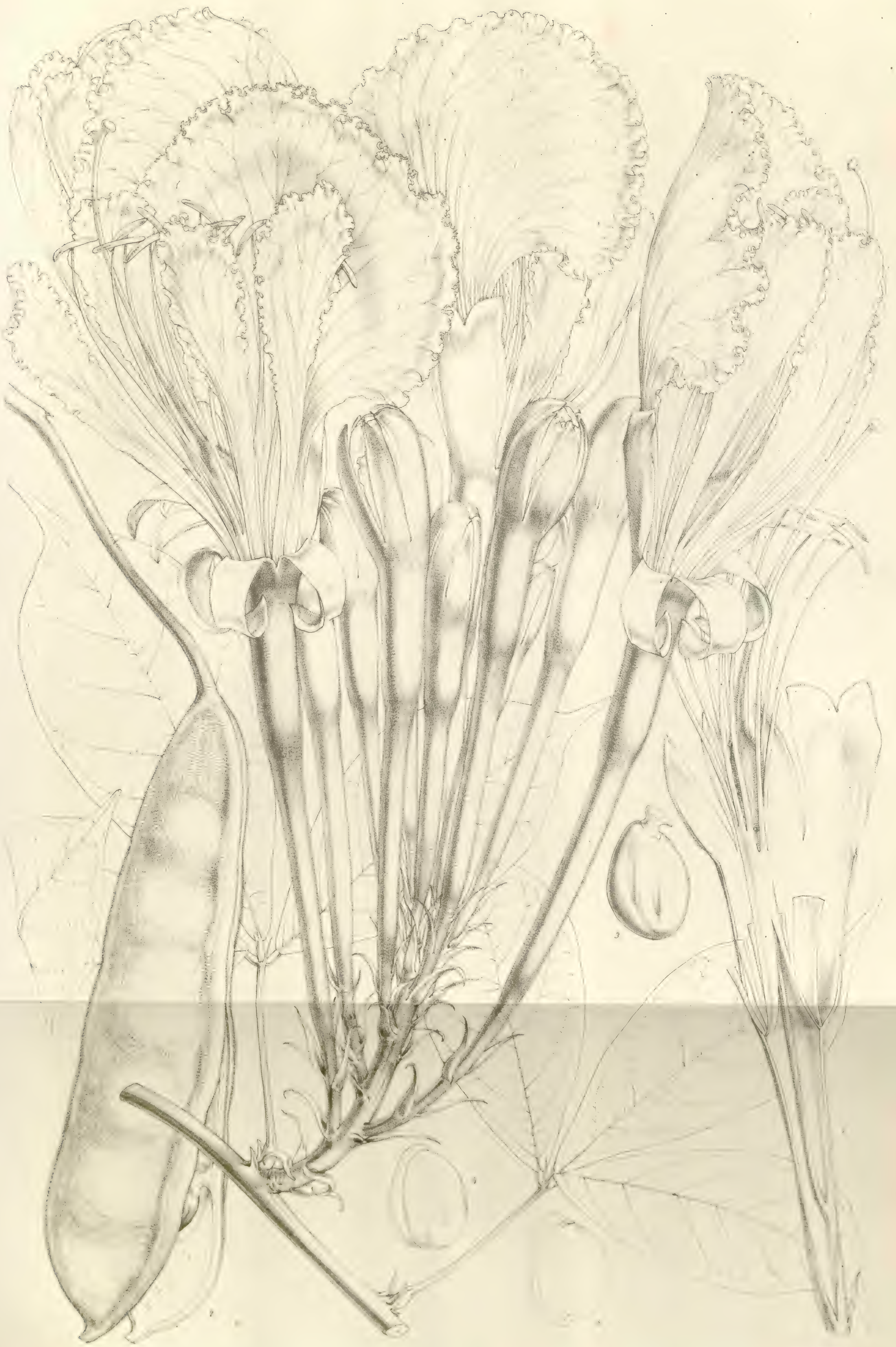
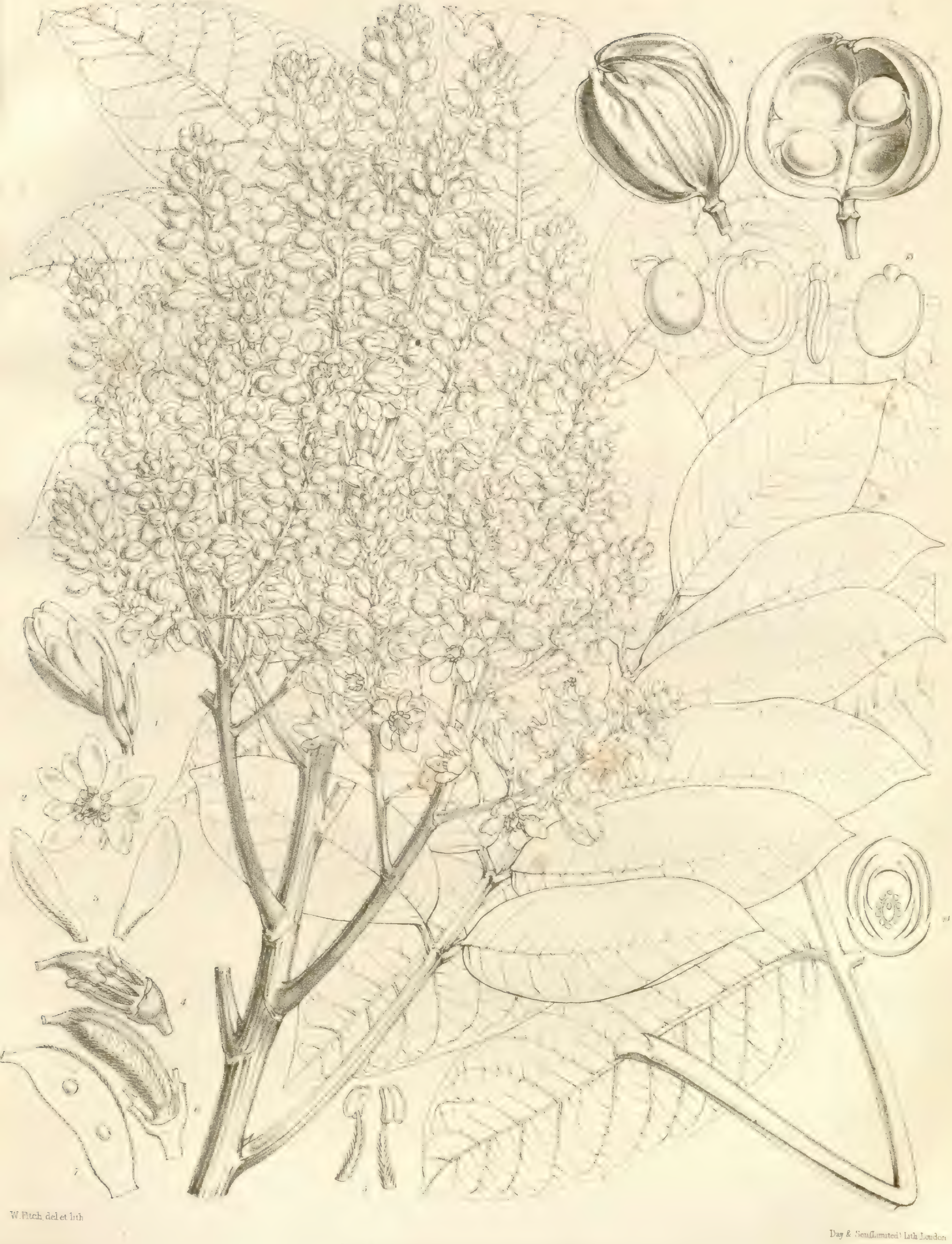
Panurea longifolia, Spruce.



Camoensia maxima, *Welw*



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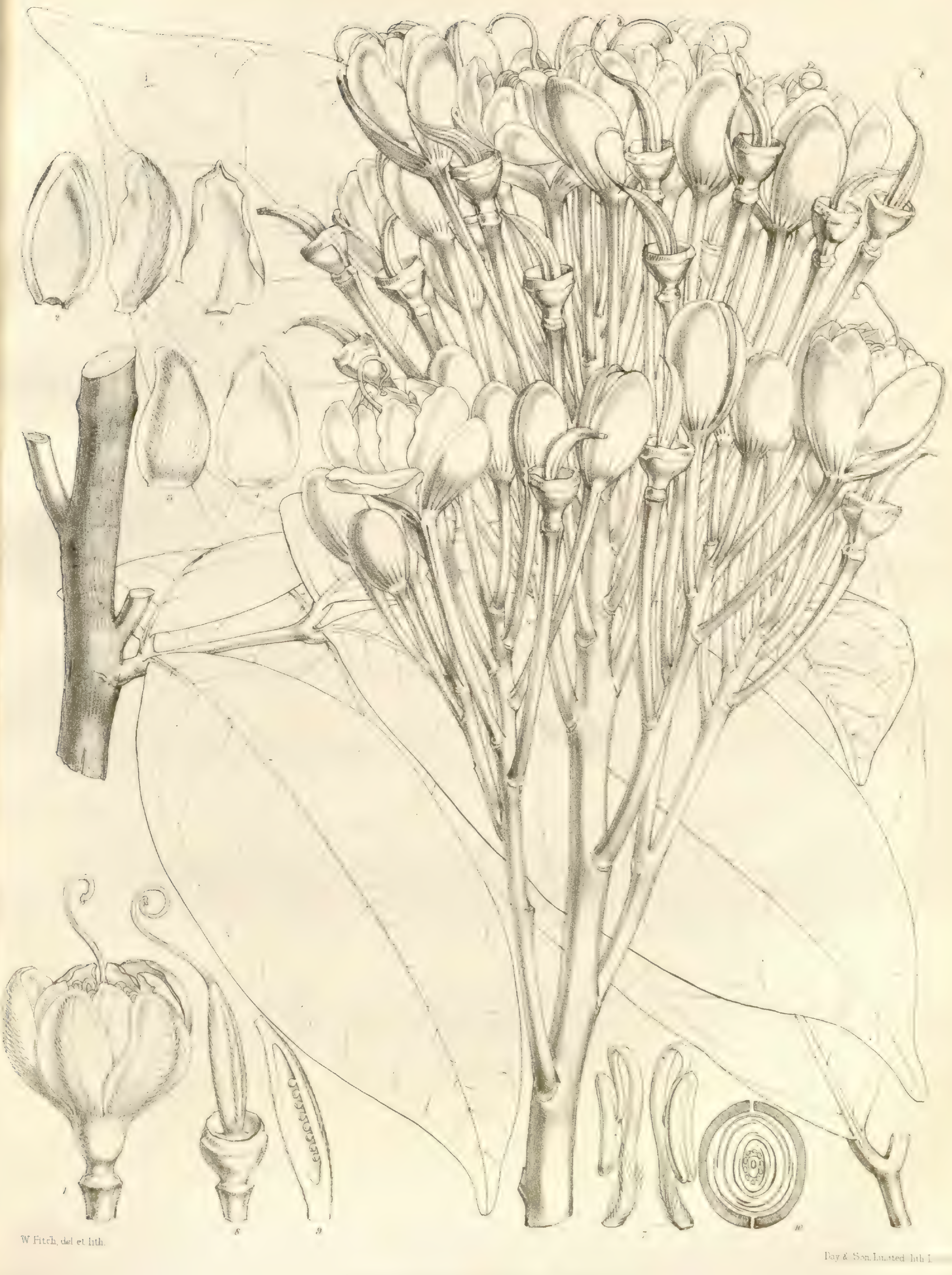
Batesia floribunda, Spruce.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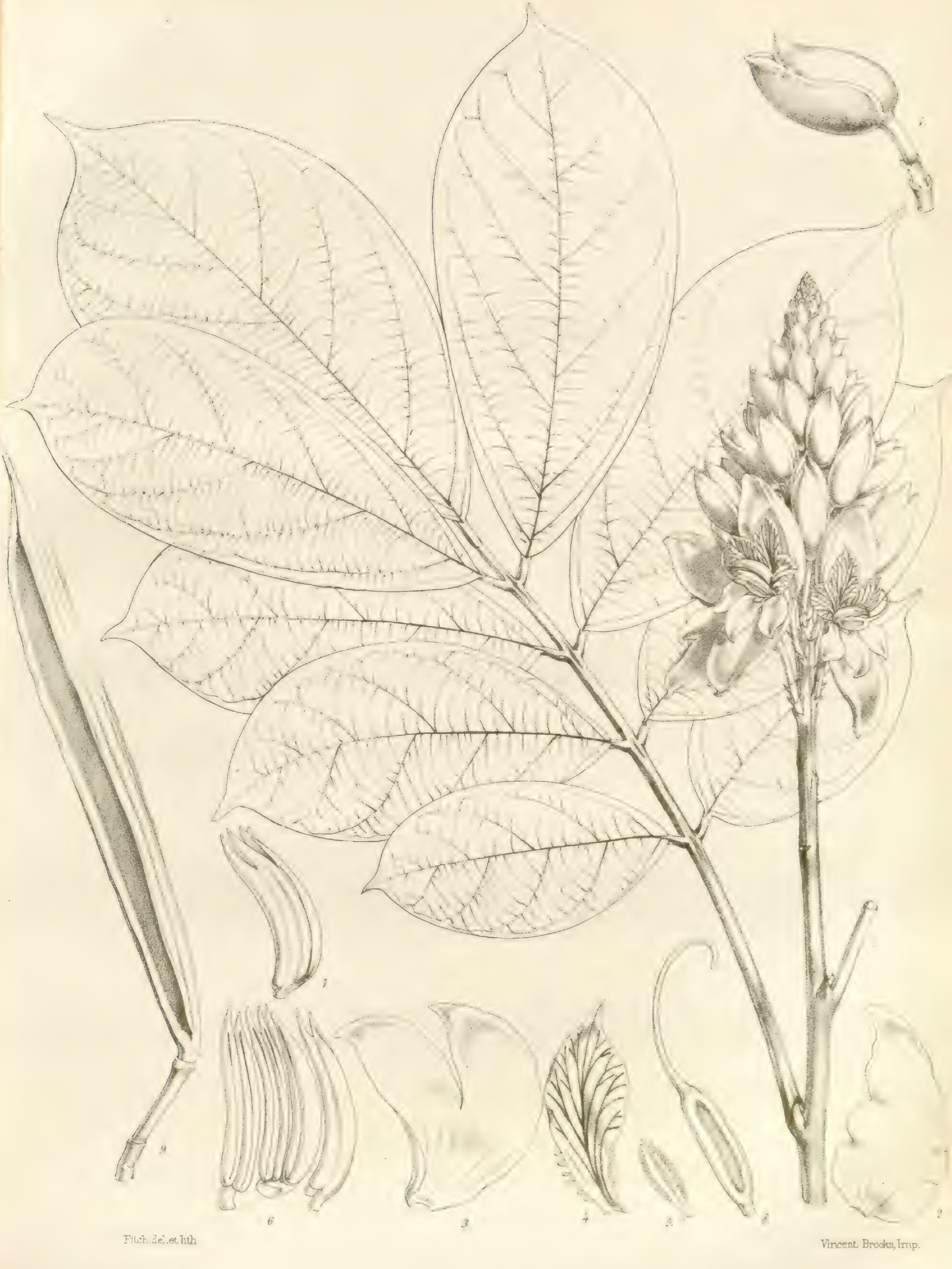
Dicymbe corymbosa, Spruce.



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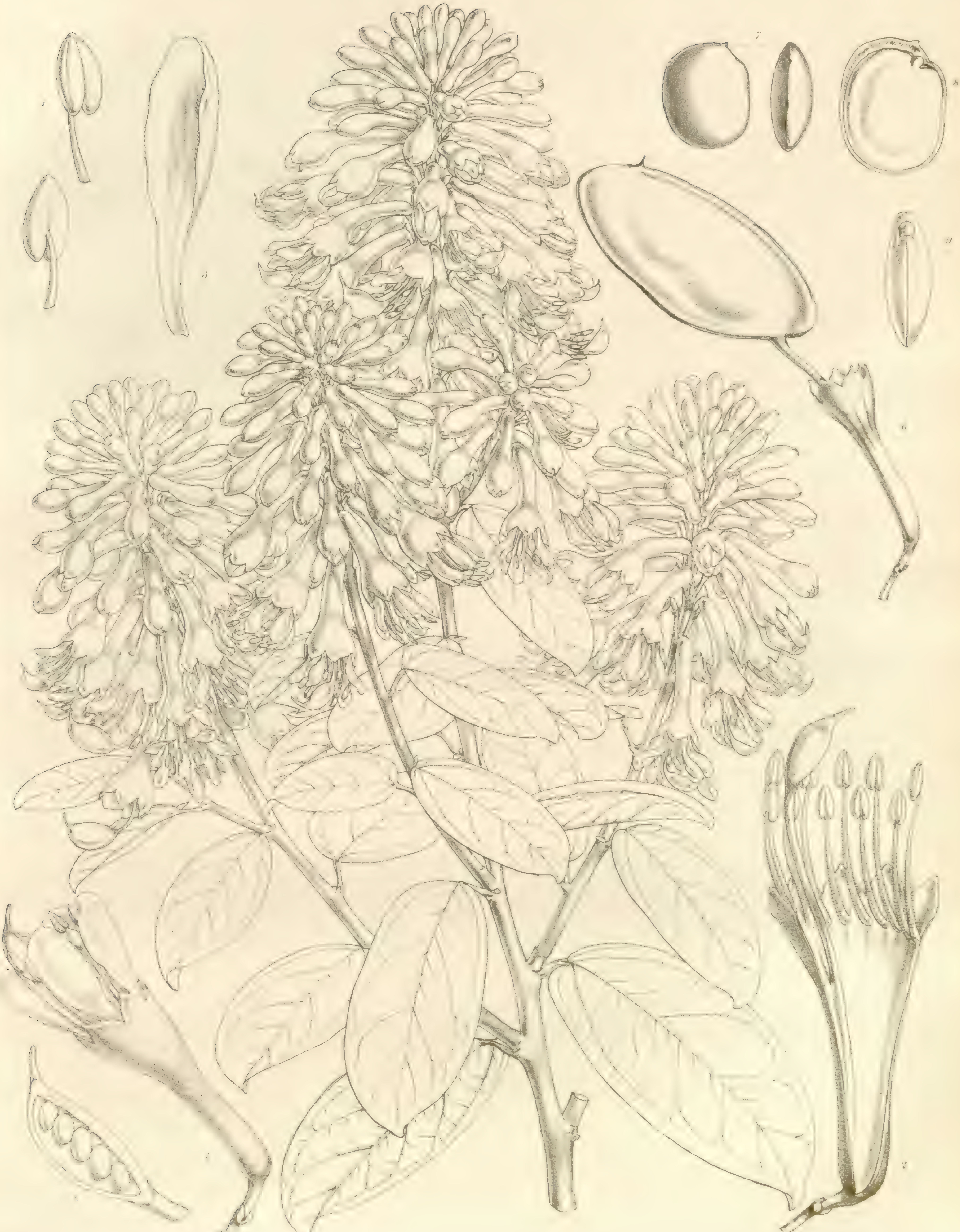
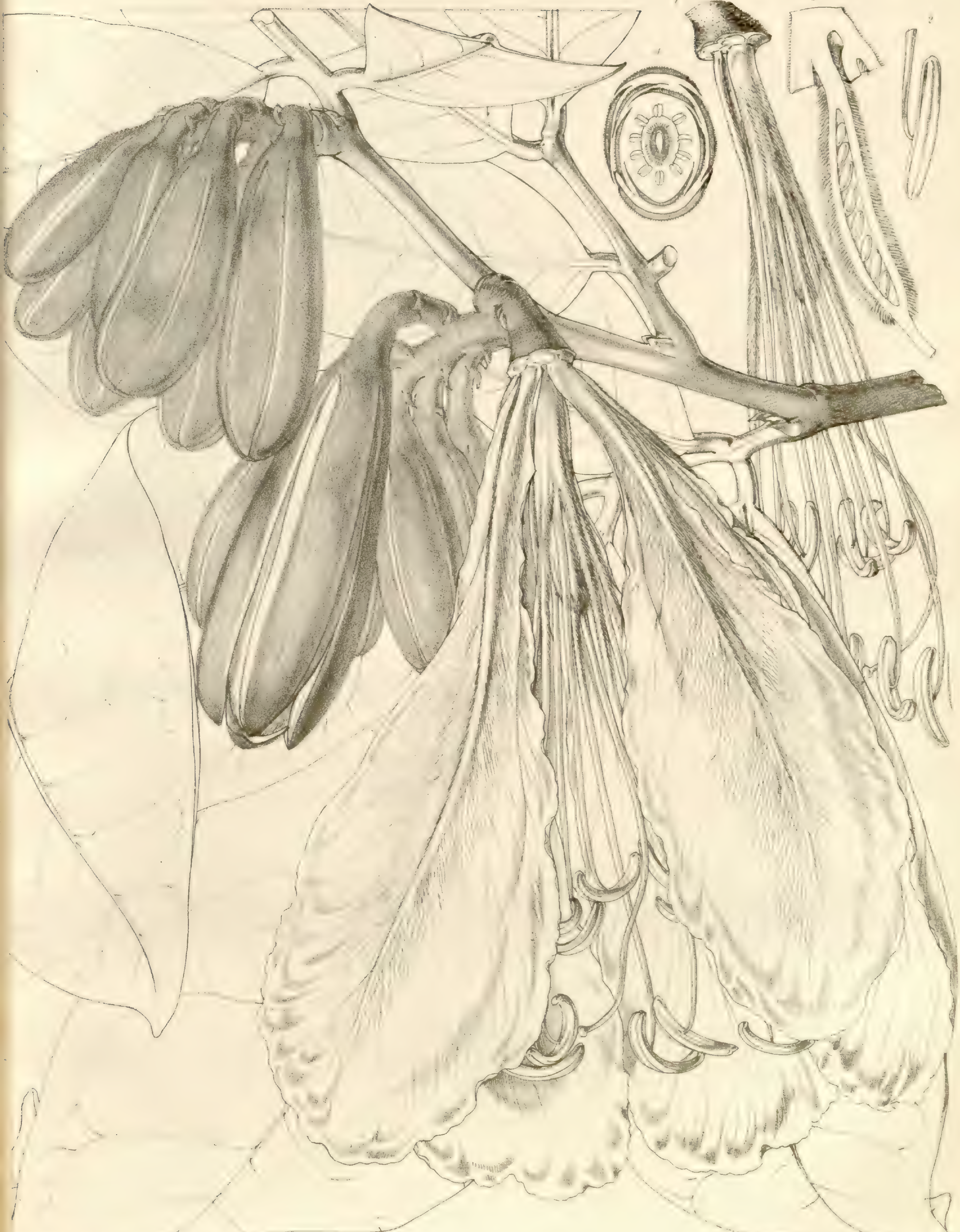
Oligostemon pictum, *Benth.*



Bandeiræa speciosa, Welw.



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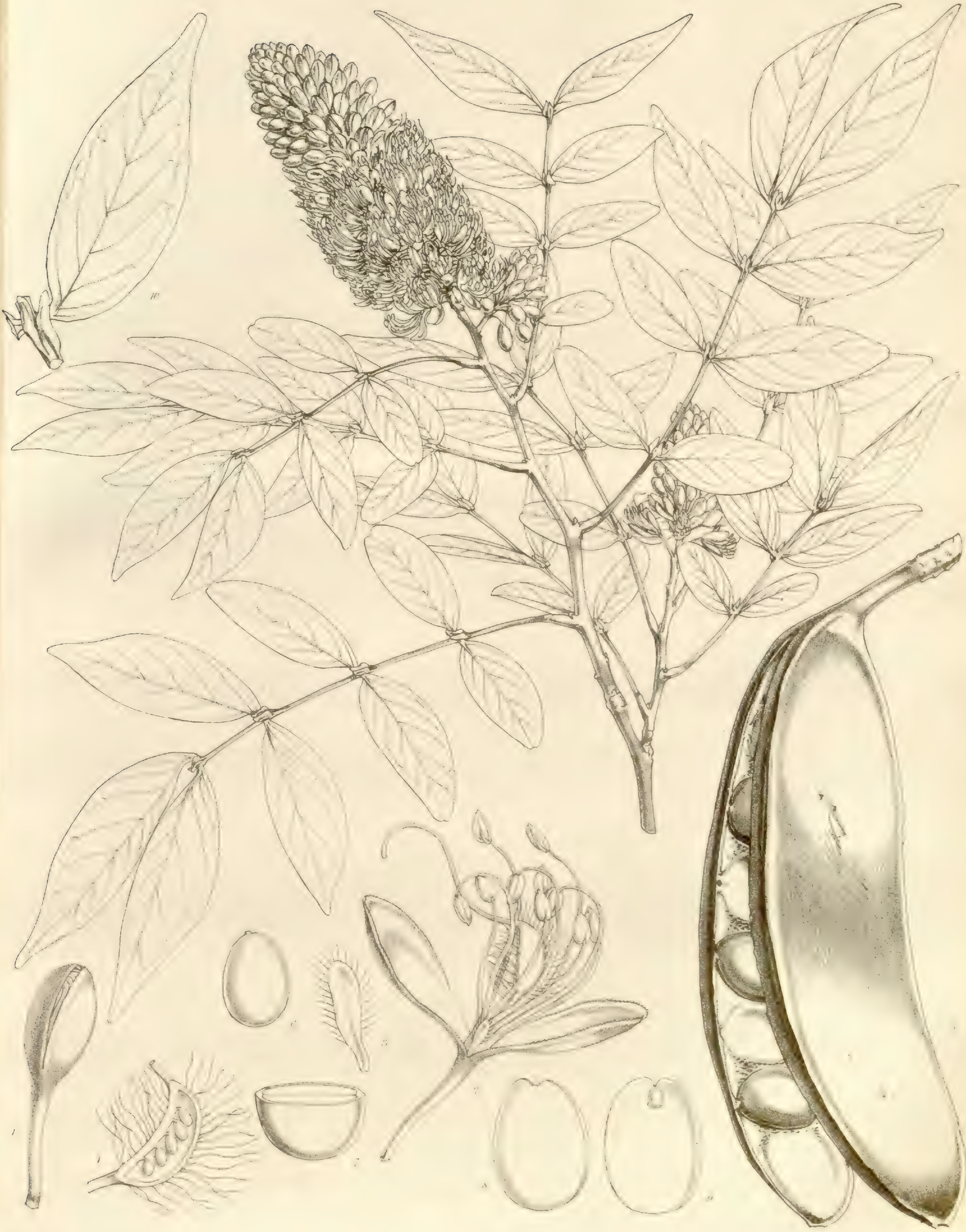
Baikiæa insignis, Benth.



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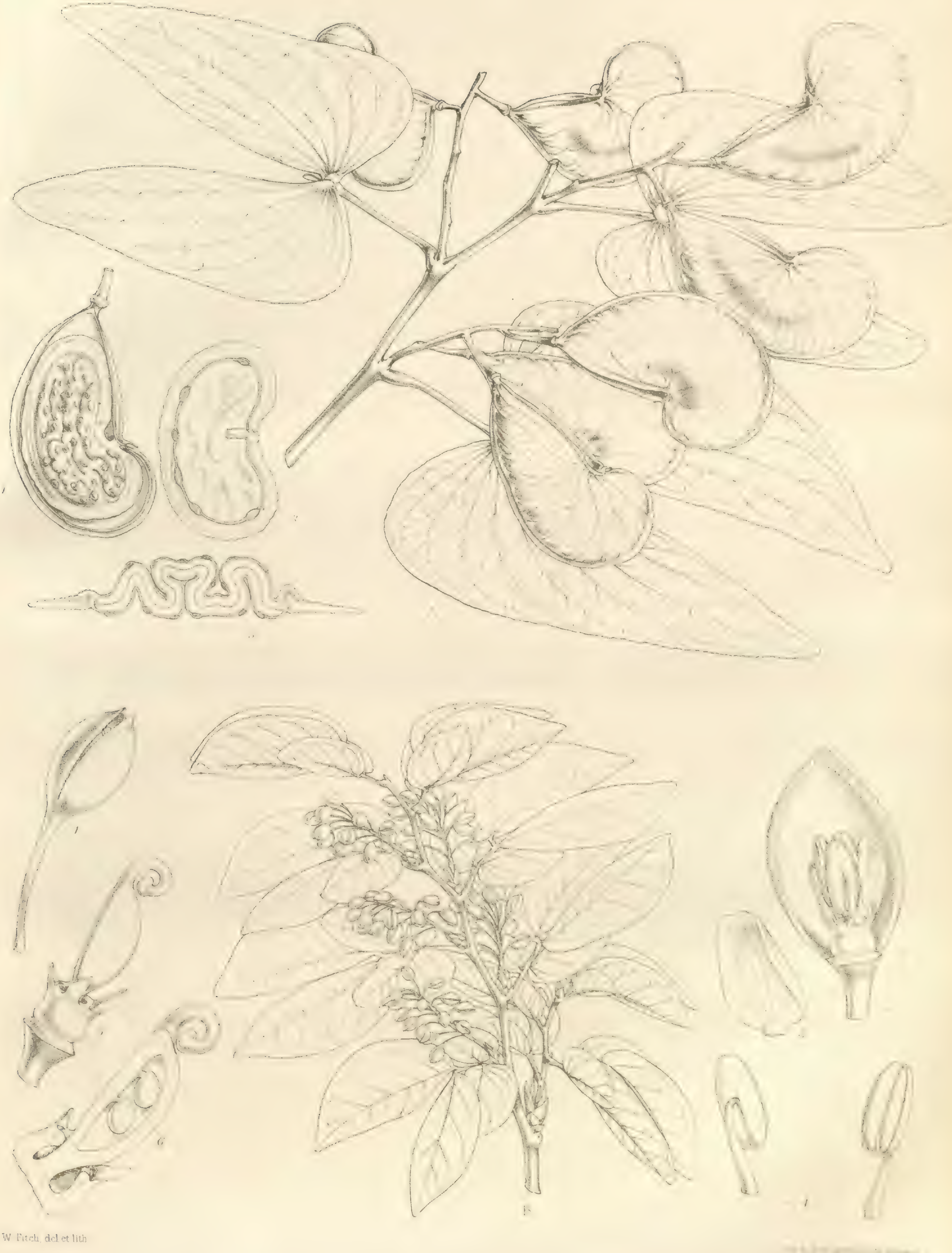
Brachystegia appendiculata. Benth.



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A Copaifera Mopane, Kirk. B. Cryptosepalum tetraphyllum Benth

X. *Descriptions of Fifty-two New Species of* Phasmidæ *from the Collection of* Mr. W. Wilson Saunders, *with Remarks on the Family.*

By Henry Walter Bates, *Esq.*

(Plates XLIV. & XLV.)

Read June 15th, 1865.

During the six years which have elapsed since the appearance of the excellent Monograph of the Phasmidæ by Professor Westwood, published under the title of a 'Catalogue' by the authorities of the British Museum, the cabinets of London have been enriched by the acquisition of a large number of new species in this group. This has been more particularly the case with regard to the extensive collection of Mr. W. Wilson Saunders; and the present memoir owes its existence to the desire of that gentleman to make them known to science in a connected form, so that the descriptions may serve as a supplement to the Monograph. In so difficult a family as the Phasmidæ every fresh acquisition serves to throw light on the limits of species and genera and their classification—questions still in a very debateable condition, owing to the insufficiency of material. The new species have been received chiefly from the islands of the Eastern archipelago, through the researches of Mr. Wallace, who had not yet finished his labours when the Monograph of Professor Westwood appeared—from Cambodia, collected by the late M. Moubot—from South-eastern Africa by M. Guenzius, Mr. Gerard, and others—from Ceylon, by M. Nietner—and from the Amazons, brought home by myself. The Phasmidæ are generally insects of great rarity and circumscribed in the range of their species, so that many, doubtless, still remain to be discovered in tropical countries. The progress of our knowledge of the group has been rapid. Thus in 1839, when Serville published his work on orthopterous insects, with the command of the principal collections of France, the total number of species he could find to describe was only 58; four years previously, Mr. G. R. Gray enumerated 108 species as all that had been described; Burmeister in 1839 (in the 2nd volume of his 'Handbuch'), making use of the Berlin collections, described 61; soon afterwards De Haan, in his work on the Entomology of the Dutch possessions, added 40 new species; Westwood, in his Monograph (1859), increased the number of described species to 471; since then 17 have been published by various authors [*], which, added to the 52 described in this memoir, make a total of 540 Phasmidæ now known to science.

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[*] 1. Bacillus (Baculus) Humberti, *Saussure*, Ann. Soc. Ent. Fr. 1861, p. 469 . . . Ceylon.
2. Bacillus (Baculus) ramosus, *Sauss. l. c.* p. 127 . . . Brazil.
3. Bacteria emortualis, *Sauss.* Rev. et Mag. Zool. 1859, p. 61 . . . Bahia.
4. Bacteria longimana, *Sauss. l. c.* . . . Bahia.
5. Bacteria spinigera, *Sauss. l. c.* . . . Brazil.

The new species added to the family in the present paper do not contribute any striking new feature to enlarge the range of grotesqueness and magnitude of form which is known to distinguish the Phasmidæ above all other insects. They enable us, however, by their confirmation or otherwise of the genera that have been proposed, to get a little insight into the working of Nature in the production of these extraordinary creatures, and to settle the groundwork of their classification. In the first place, the very great apparent diversity in the family, with very little real departure from the family type, becomes more marked as our knowledge of the group increases. There are species with bodies so attenuated that they resemble smooth stems of grass, others of great bulk, armed on body and limbs with tegumentary lobes or spines, and others, again, dilated into thin leaf-like expansions. Some have extremely short antennæ, and others have these members excessively elongated. The head is most diversified in shape—globular, conical, oval, linear, spined or smooth, furnished with important organs (like simple eyes) or destitute of them. Some species are wingless in both sexes, others are winged in the male and wingless in the female; many, again, are winged in both sexes, whilst others have rudimentary wings either in one sex only or in both. The abdomen and its appendages, and the legs, have also profound modifications of form. It is seldom that these diversities of structure help us in classification; species agreeing in some one or two features that might be generic differ greatly in other features which might equally be considered generic. Each species, almost, has well-marked and apparently important structural peculiarities, and the definition of generic groups is a matter of extreme difficulty. There is very little difference in habits of life; all are vegetable feeders, necessarily sluggish in motion, owing to their elongated and many-segmented forms, and pass their lives on trees. This irregular diversity is perhaps only an exaggeration of what is seen in many other groups of animals and plants, and its explanation may be sought in the homogeneity of type of a group with much adaptive modification of its members. When a group is easy to classify or subdivide, this probably results from real heterogeneity of type—a heterogeneity which is fundamental, but not sufficiently great to prevent the component parts from being included in the group. Now the Phasmidæ appear to consist of a set of forms typically moderately elongate or cylindrical, and winged in both sexes, as in other families of the order (Orthoptera) to which they belong, but which have become

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6.	**Bacteria azteca**, *Sauss. l. c.*	Mexico.
7.	**Bacteria polteca**, *Sauss. l. c.*	Mexico.
8.	**Bacteria baculus**, *Sauss. l. c.*	America.
9.	**Bacteria (Bacunculus) æstuans**, *Sauss.* Ann. Soc. Ent. Fr. 1861, p. 474, pl. 11. fig. 2	Old Calabar.
10.	**Bacteria cornuta**, *Sauss.* Rev. et Mag. Zool. 1861, p. 128	Mexico.
11.	**Bacteria subnematodes**, *Giebel*, Zeitschr. f. d. gesammt. Naturwissensch. xviii. p. 113	Java.
12.	**Acanthoderus mexicanus**, *Saussure*, Rev. et Mag. Zool. 1859, p. 62	Mexico.
13.	**Acanthoderus (Xylodus) adumbratus**, *Sauss. l. c.* p. 62	Porto Rico.
14.	**Cladoxerus rubus**, *Sauss.* Rev. et Mag. Zool. 1861, p. 128	?
15.	**Bactrododema** (n. g.) **tiarata**, *Stål*, Öfversigt af Kongl. Vetensk. Akad. Förhandlingar, xv. p. 308	Damara Land.
16.	**Achrioptera** (n. g.) **fallax**, *Coquerel*, Ann. Soc. Ent. Fr. 1861, p. 495, pl. 9. fig. 1	Madagascar.
17.	**Prisopus mexicanus**, *Saussure*, Rev. et Mag. Zool. 1859, p. 61	Mexico.

variously modified in external structure in the direction of disguises to guard the species against extermination by their enemies. It is thus that from the Phasma type have been produced the narrow, green or yellow, apterous Bacilli, with their habit of stretching out rigidly their elongated limbs when clinging to a plant, so as to assume the appearance of a slender stem—the flattened and rugged-lobed, mossy-looking Prisopi and Creoxyli, which, when the wings are folded, cannot be distinguished from a piece of lichen-covered bark—the flattened Phyllium, which, as every one knows, cannot be distinguished from a leaf of the tree on which it crawls—and so forth, the adaptation of general form carrying with it modifications of limbs and appendages. The difficulty which we find in defining generic groups in the family is explicable on the ground that, where there is much of this adaptive modification, all the corporeal parts concerned must have become to a high degree variable. Natural selection having, from the first, favoured the species which offered variations in these parts, the tendency to variability has become perpetuated by inheritance. There can be no other explanation of the persistence of certain structures throughout a range of species—the persistence which enables naturalists to define generic and other groups—than that, in the long process of multiplication of forms in Nature, these parts have not been involved in the process of adaptation. It is a strong proof of this persistence having prevailed in Nature, that all naturalists of the old school have held so firm a faith in the original creation of genera as well as of species. To state it in simple language, they believed that when a species was created it was endowed with certain features in common with other allied species: a newly-originated form was thus thought to receive its generic as well as its specific stamp. A group like the Phasmidæ, therefore, ought, instead of perplexing us, to be regarded with high interest, as showing that the existence of generic characters is not a universal rule, and as affording a probable explanation why it is not.

In the following descriptions I have followed the classification of Professor Westwood, who adopted its main features from Lichtenstein, Gray, Burmeister, and their successor, De Haan, the author of one of the best treatises on the family, comprised in his work on the Entomology of the Dutch possessions. The groundwork of this classification is the gradation in development of the wings from genus to genus. Thus it begins with those genera which are wingless in both sexes, these forming one *Division*, and passes through those in which the males are winged and the females wingless, or in which the wings are rudimentary, to the genera which have well-formed wings in both sexes—the whole of the latter forming the second *Division*. The wingless series commences with those forms which have much-abbreviated antennæ and very attenuated bodies, and progresses to those having long setiform antennæ, or bodies of much more compact structure. The winged series progresses gradually from those genera in which the upper and lower wings are either rudimentary or developed in one sex only, to those in which they exist in both sexes (but the upper wings of extreme shortness), ending at length with genera in which both upper and lower wings have become elongated in an approach to due proportion. This classification has lately been severely criticised by Dr. Gerstaecker, the author of the Entomological portion of the Berlin annual Report on the progress of Zoology.

He points out that in certain cases where the unwinged female alone was known, the author of the Monograph himself confessed he could not decide whether the species belonged to the winged division (*i. e.* winged in the male) or to the apterous division; and in one instance at least, *Lonchodes feruloides,* he had placed a species in the apterous division, which, now that the winged male was known, proved to be a *Phibalosoma* of the winged division. This implied that winged and wingless species (in the male) might be included under one and the same genus; and the critic argued, from the analogy of other families of Orthoptera where genera occurred containing both forms (e. g. *Saga, Gryllacris,* &c.), that the alary structure was an erroneous principle to adopt in the classification of these insects. To the instance brought forward by Gerstaecker I can add several others. For instance, *Acanthoderus bufo* (Westw.), an apterous species, has, except in wings, all the essential characters, and especially the elongated anal pseudosegment in the female, of the genus *Heteropteryx,* which is winged in both sexes. In another case, the genus *Dimorphodes,* whose males are winged, a new species has been taken by Mr. Wallace in the islands of Batchian and Ternate, very closely allied in the female to Westwood's typical species of the genus, but apterous in the male sex. Other less decisive cases might be mentioned.

A careful examination of the extensive series of Phasmidæ in the Saundersian collection has convinced me that the objections thus producible against a classification founded on the absence or presence of wings, could be brought forward with equal justice if other organs were taken as the groundwork. The only other classification of the family which has been proposed is the one first sketched out by Latreille and developed by Serville, and which takes various other features as guides, especially the armature of the legs. This leads to equally artificial results, such as separating widely *Bacteria* and *Bacillus, Phibalosoma* and *Bacteria,* and so forth. The wording of the objections to the alary system by the Berlin Professor, as in all such cases, implies that there exist in the nature of the thing the materials for a neatly definable classification of the group, which the Monographer had failed to discover. But I believe such materials do not in this case exist. In other words, I believe that in the Phasmidæ, as in some other groups, Nature, in adapting her species to their conditions of life, has, in the process of variation and adaptation, involved all those parts of structure which usually yield, by their partial constancy, characters for the definition of generic groups. The type of structure of the family is, moreover, as I have before said, homogeneous to an unusual degree, considering the very wide range of dissimilarity that it embraces. This explains why apterous species are so closely allied by affinity to winged species, and why, when other parts of structure are taken for characters, species are widely sundered which in reality are closely related. The family is an isolated one in its order, so much so that it is impossible to say what genus in it is more nearly related to a neighbouring family than any other genus; and as its type was evidently simple at its origin, and not compounded of two or more allied types which, throughout their subsequent modification, have not receded too far to be included in one family, all the existing species are very closely related to each other. It has even been shown by writers on the group that the principal great modifications of structure which do exist, namely those involving the thoracic segments, are due to the development or non-development of the wings. This is also a proof of the homogeneity of the type; for we have seen how the possession of wings is little better than a specific character.

For these reasons I have not thought it necessary, in describing the following large number of new species, to make any considerable alteration in the classification adopted by Professor Westwood. The species possessing wings in both sexes seem to be generally more nearly allied to each other than any of them are to apterous species. Some of his genera might be improved by withdrawing a portion of their contents, and placing them in other genera; and it will perhaps be necessary, eventually, to establish several new ones; but, upon the whole, his work seems to place the forms in tolerably natural order. The genera with lengthened upper wings (tegmina) are properly placed near together, and the elongated apterous ones, with equal propriety, brought into proximity. But I think it would be very desirable to abolish the two divisions, and bring several of the apterous genera into nearer connexion with the winged ones. For instance, *Lonchodes* and *Bacteria* with *Phibalosoma*; *Acanthoderus* and *Eurycantha* with *Heteropteryx*, and so forth. The genus *Anophelepis* (containing species with very rudimentary wings) would perhaps be better abolished, and its contents distributed amongst other genera—for instance, *An. xiphias* and *An. despecta* to *Bacteria*, and *An. vittata* to *Ceroys*, the characters of these genera being altered to suit the change.

Habits.—There is very little to say about the habits of the Phasmidæ. They are wholly vegetable feeders, and are seen in the tropical forests, where they are most numerous, clinging closely to stems or crawling slowly over the foliage of bushes and trees. Belonging to the Orthopterous order, they, of course, do not undergo a metamorphosis in the proper sense of the word, having a similar form when they emerge from the egg to that which they present in the adult state, and continuing active at all stages of their existence. So similar is the full-grown larva and the so-called pupa to the adult, that the old authors sometimes described these adolescent forms as adult insects, and all authors describe new species from examples in the earlier stages, as it is generally not difficult to recognize the adult by a description of a pupa. They undergo several changes of integument; and in the stage preceding the adult the wings first appear as inarticulated foliaceous lobes on the thoracic segments. Like the rest of the Orthoptera, which is an order situated low in the scale of development of the insect type, there is very little or no consolidation of the segmentary structure of the body. The Phasmidæ have the full number of freely-articulating segments characteristic of the abstract insect type—a feature retained only in the larval condition by most of the higher orders of insects with perfect metamorphosis. These segments being elongated, the movements of the insects are necessarily sluggish; and the slowness of movement is increased in many species by the bulk and weight of the entrails, the Phasmidæ being voracious feeders, and the elasticity of the connecting membranes of the abdominal segments admitting of increased bulk to the body. Wings to such creatures are not of much use as organs of distant and rapid locomotion. We know that wings in some other allied families of Orthoptera are supplemented by saltatorial hind legs, as in grasshoppers, crickets, &c.; but the Phasmidæ have not this advantage, and the wings seem to serve little better than as parachutes, or to float their possessors from one tree to another. In the economy of the species, this limited power of locomotion must be of some use; but the numbers of apterous forms in close alliance with the winged ones show that some Phasmidæ can maintain their own in the battle of life as well without as with organs of flight. They are, however, insects of rare occurrence, and in my own experience in the Amazons region I found only one that was distributed over a wide extent of country. Some of them, as I have recorded under the head of *Phasma putidum*, have the power of emitting a fetid liquid when alarmed; many others are armed with sharp spines on their legs or body; numerous species, as I have before stated, have a perfect disguise in their resemblance to a stem of grass, a dead branch, a mossy chip of bark, a leaf. All these properties, it is needless to remark, are the varied means by which these apparently helpless creatures succeed in maintaining their place by the side of the nimbler and more compactly organized families of insects. Some species of *Phasma* and *Necroscia* (winged in both sexes) have no disguise, but, on the contrary, brilliant and varied colours: what means of protection they enjoy is unknown, but the fact shows the justice of the view that these are typical Phasmidæ; they have not been perverted by the agencies of special adaptation into a resemblance to a stem of grass or a leaf.

The method of copulation I have described below in the remarks on *Phasma putidum*. The females, according to Lansdown Guilding, drop their eggs first into the concave seventh ventral segment, which, together with the two remaining segments, is curiously changed from the normal form, apparently for this purpose, the eggs remaining there until their shells are dry and hardened, when they are deposited at random.

BACILLUS GRAMINEUS, n. sp. *B.* elongatus, tenuis, pallide viridis; capite elongato, inermi, haud convexo, lateribus subparallelis; mesothorace leviter granulato; abdomine stylis analibus valde curvatis pubescentibus; pedibus elongatis, tenuibus, inermibus; antennis 15-articulatis, brevibus, subuliformibus, articulis duobus basalibus depressis (*mas*).—Long. corp. 2″ 3‴; cap. 1¾‴; anten. 2¼‴; prothor. 1‴; mesothor. 4½‴; metathor. 5½‴; abdom. 1″ 2¼‴. (Plate XLIV. f. 4.)

Resembling *B. Stellenboschus*, Westw. (Cat. Phasm. plate ii. fig. 4), in colour and size, but differing from that species in the slenderness of the thighs, which are filiform and unarmed. It has some affinity also with *B. natalis*, Westw. (Cat. Phasm. plate xxiii. fig. 7); but the legs, although long and slender, do not reach the excessive tenuity which they exhibit in that species, and the middle legs are strikingly smaller, compared with the other legs, than in *B. natalis*.

Head elongate, scarcely narrowed behind, pale green; eyes scarcely prominent. Antennæ short, the two basal joints depressed (not so broad as the third), the rest thick, and the whole tapering to the apex. Thorax light green, paler and yellowish in the middle of the dorsal surface, mesothorax a little shorter than the metathorax, and slightly granulated over the surface. Abdomen light green, not dilated at the apex, apical dorsal segment obtuse; anal styles pubescent and strongly curved inwards; genital segments short, not passing the end of the eighth dorsal segment, moderately convex. Legs elongated, all equally slender and unarmed, the middle pair somewhat shorter than the others.

Hab. One example, from Natal. (The artist has represented the middle legs too long in the figure.)

Bacillus aspericollis, n. sp. *Fœmina.* Cylindricus, tenuis, pallide luteus; capite elongato, haud convexo, lateribus parallelis; antennis subuliformibus; mesonoto dorso lævi, lateribus fortiter granulatis, metathorace sublævi; abdomine apicem versus attenuato, stylis analibus rectis compressis, operculo brevi; pedibus modice elongatis, inermibus.—Long. corp. 2″ 10‴; cap. 1¾‴; anten. 2¼‴; prothor. 1¼‴; mesothor. 5½‴; metathor. 7‴; abdom. 1″ 5¾‴; styl. anal. ¾‴.

Head elongate, thick, scarce perceptibly narrowed behind, eyes not at all prominent; pallid, dingy-ochreous, with a dusky line on each side behind the eyes. Antennæ with the basal and second joints depressed (not so wide as the others), the rest thick and gradually tapering to the apex. Mesothorax smooth, with the exception of the edge of the mesonotum on each side, which has a row of rather sharp, raised granules; these continue also along the edges of the metanotum, but are there much less prominent, and remain of the same colour as the thorax, namely dingy pallid ochreous. Abdomen smooth, very tapering at the tip, which is furnished with two moderate-sized, compressed and straight anal styles. The genital operculum is very short, similar to that of *Bacillus Peristhenes* (Westw. Cat. plate viii. fig. 2), and scarcely passing beyond the commencement of the eighth ventral segment. A short anal segment or plate is visible at the apex of the terminal (ninth) dorsal segment of the abdomen. Legs moderately short (like *B. Rossii*), and quite unarmed.

Hab. This insect, which is possibly the female of *B. gramineus*, is also from Natal.

Bacillus Guenzii, n. sp. *B.* filiformis, lævis, inermis, luteo-viridis, meso- metanotoque lateribus nigro lineatis; capite oblongo, supra plano; antennis 16-articulatis, mesothorace longioribus; abdomine ante apicem paulo dilatato, segmento dorsali terminali apice emarginato, segmentis genitalibus fortiter tumidis; stylis analibus brevibus, rectis; pedibus modice elongatis, inermibus (*mas*).—Long. corp. 2″ 3‴; anten. 8‴; mesothor. 6‴; metathor. 4½‴; abdom. 1″ 3‴. (Plate XLIV. f. 14 *a*.)

Bacillus Guenzii belongs to the same group as *B. gracilipes*, *Stellenboschus*, and *natalis* (Westw.). It appears to be most nearly allied to *B. Stellenboschus*, but differs at once from this species by the shortness and linear form of the anal styles.

Head oblong, very slightly narrowed behind, sides behind each eye with a longitudinal furrow, surface-plane dingy-yellow, dusky on the crown, and with a dusky line on each side; eyes very prominent; antennæ 16-jointed, rather more slender than in the allied species, basal joint flattened and tumid beneath at the apex. Pronotum uneven. Meso- and metanota with a black streak on each side, dorsal surface (in dried example) red. Abdomen filiform, with the three terminal segments of nearly equal length; antepenultimate dilated towards the apex, dilated sides (together with those of the penultimate) deflexed; apical segment scarcely convex, angles rounded off, tip emarginated in the middle; genital segments much inflated, but not reaching beyond the tip of the penultimate dorsal segment. Anal styles short, straight, scarcely visible beyond the tip of the abdomen. Legs moderately elongated, intermediate pair short (fore leg 2″ 1‴; intermediate 1″ 4‴; posterior 1″ 9‴).

Hab. Natal: from the collections of M. Guenzius.

Bacillus patellifer. *Fœmina.* Cylindricus, robustus, granulatus, viridis; antennis brevibus, filiformibus, articulo basali magno, ovato, complanato; capite postice attenuato, inermi; femoribus anticis serratis, reliquis inermibus; segmento sexto ventrali margine postico producto acuto; operculo usque ad apicem dorsalem protenso, angusto, vix convexo, obtuso.—Long. 4″ 3‴; anten. 6‴; mesothor. 10½‴; metathor. 8½‴; abdom. 2″+6‴=2″ 6‴; ped. intermed. 1″ 11‴; ped. post. 2″ 9‴.

Allied to *Bacillus cuniculus* and *B. Hyphæreon* (Westw. Cat. plate vi. figs. 1 & 2), but quite distinct from either.

Body moderately thick, cylindrical, and covered throughout, closely and regularly, with small acute granulations, yet the integument is slightly shining: the colour light green. Head stout, moderately narrowed in a straight line behind the eyes, which are slightly prominent. Basal joint of antennæ large, ovate, and flattened from base to apex, second joint also dilated, the rest filiform. Apical dorsal segment quadrate; sixth ventral segment with the hind margin produced and acute in the middle; operculum reaching the tip of the abdomen, obtuse, narrow, and scarcely convex; anal styles short, filiform, pointed. Legs moderately stout, ridges of middle and hind femora with a few minute spines, upper and lower ridges of anterior pair strongly serrated. Tarsi simple.

Hab. Darjeeling (*Mr. Russell*): Coll. W. W. Saunders, Esq.

Bacillus scytale, n. sp. *B.* cylindricus, elongatus, lævis, luteus; capite oblongo, postice attenuato, inermi, linea transversa inter oculos elevata; oculis prominentibus; antennis articulo basali magno dilatato; abdomine segmento dorsali terminali apice medio inciso, angulis apicalibus distinctis; pedibus validis, modice elongatis, femoribus anticis supra serratis, intermediis posticisque apice infra unidentatis, tibiis quatuor posticis apices versus serratis (*fœm.*).—Long. corp. 6″; mesothor. 16‴; metathor. 12‴; abdom. 3″ 1‴. (Plate XLIV. f. 9.)

Agrees in size, form, and armature of the legs with *B. cuniculus* (Westw.), but differs in wanting the cephalic horns which distinguish that species.

Head oblong, narrowed behind, unarmed, but with an obtuse, thick transverse ridge between the eyes; basal joint of antennæ dilated and flattened (broken beyond the fourteenth joint). Thorax cylindrical and smooth. Abdomen smooth; seventh dorsal segment two-thirds the length of the sixth; eighth little more than half the length of the seventh, and considerably shorter than the terminal segment; the latter with the apical edge notched in the middle and with the lateral angles distinct; operculum (♀) reaching the extremity of the abdomen, inflated and keeled towards the tip; anal styles short, straight, concealed. Legs moderately elongated, intermediate pair short; anterior femora serrated along their upper edge; middle and hind femora with a tooth-like spine beneath near the tip; four posterior tibiæ with the raised lines towards the apex finely serrated; basal joint of the tarsi about the same length as the three following joints taken together.

Hab. Ceylon: Coll. Nietner. This species, with several others having a similar form of antennæ (large, flattened basal joint), will range under the genus *Ramulus* of M. de Saussure; it is closely allied to *Bacillus* (*Ramulus*) *Humberti* of this author (Annales d. l. Soc. Entom. de France, 1861, p. 472).

The genus *Linocerus* of G. R. Gray (Synopsis Phasm. p. 20) appears to be the same as *Ramulus*, and the name will take precedence if the genus is adopted.

Bacteria cyrtocnemis, n. sp. *B.* cylindrica, viridis, calamum viridem simulans; capite valde convexo, vertice spinis duabus armato; thorace inermi; abdominis segmento dorsali ultimo apice emarginato; operculo vaginali angustato, depresso, abdominis apicem haud superante; stylis analibus brevibus, rectis; pedibus valde angulatis, modice elongatis, femoribus intermediis curvatis prope basin spinis foliaceis binis utrinque armatis (*fœm.*).—Long. corp. 5″; anten. 3″; mesothor. 1″ 3‴; metathor. 10½‴; abdom. 2″ 6‴. (Pl. XLIV. f. 10.)

Head with the crown much raised, the front part of the elevation having two strong and short, acute spines directed obliquely forwards. Thorax unarmed. Abdomen cylindrical to the apex; the apical segment equal in length to the preceding, its apical edge triangularly emarginate; the vaginal operculum narrow, not at all convex, pointed at the tip, and not passing the apex of the abdomen; anal styles short, straight, obtusely pointed. Legs moderately stout, scored between the raised lines, which are strongly elevated and compressed; the fore and hind legs are elongated and simple; the middle femora are strongly curved, and have, at one-fourth their length from the base, on each side, a flattened expansion divided into two tooth-like points. The basal joint of all the tarsi is much elongated. The colour of the entire insect is pale green, and in life it bears the closest resemblance to a stalk of grass, or rather the midrib of a palm-leaflet.

Hab. One example, taken at Ega on the Upper Amazons.

Bacteria laticauda, n. sp. *B.* cylindrica, tenuis, glabra, olivaceo-viridis, capite prothorace pedibusque rufescentibus; capite inermi; abdominis segmentis tribus apicalibus dilatatis, segmento ultimo apice late emarginato; stylis analibus brevibus, rectis, filiformibus; pedibus elongatis, femoribus quatuor posticis apice subtus bispinosis et denticulatis (*mas*).—Long. corp. fere 5″; anten. 4″ 3‴; mesothor. 1″ 3‴; metathor. 10½‴; abdom. 2″ 5‴. (Pl. XLIV. f. 11 *a*.)

Head oval, scarcely convex, unarmed, reddish. Antennæ very long, dusky. Meso- and metathorax dark green, very smooth, and slightly shining, scarcely enlarged at the insertion of the legs. Abdomen dark-green, light-brown towards the apex; the three apical segments of nearly equal length (the apical one the shortest), each being about half the length of the sixth segment; the seventh is strongly dilated from base to apex; the eighth is of greater width, its sides being only moderately deflexed and its angles rounded; the ninth or terminal segment is less broad, and of nearly square shape, but convex above, its front edge broadly excised, its margins smooth, not thickened, and its angles prominent but obtuse; the anal styles do not project beyond the sides of this segment, but are pendent, short, and nearly straight; the terminal ventral segments are very gibbous. The legs are long, slender, and of a reddish hue; they are unarmed, with the exception of the apical part of the four posterior femora, which, beneath, are furnished with a row of denticulations, two of which are larger than the rest, and spiniform; the basal joint of the tarsi is quite simple, being neither compressed nor crested.

Hab. One example, taken at Ega on the Upper Amazons.

Bacteria amazonica, n. sp. *B.* cylindrica, tenuis, omnino inermis, fusco-lutea; capite ovali, subconvexo, rufescente, supra fusco trivittato; thorace lævi; abdominis segmentis tribus apicalibus brevibus, haud dilatatis; segmento ultimo minore, supra bifoveolato, lateribus bisinuatis, margine apicali incrassato, leviter emarginato; segmentis apicalibus ventralibus fortiter gibbosis, gibbo medio carinato, apice obtuso. Pedibus simplicibus, tarsis omnibus elongatis, articulo basali simplici (*mas*). —Long. corp. 4″ 2‴; anten. 4″; mesothor. 1″ 1‴; metathor. 10‴; abdom. 2″.

The distinguishing characters of this species are the narrowness of the seventh and eighth dorsal abdominal segments, whose lateral margins are continuous with those of the preceding, and the shape of the apical segment. In general form the species does not differ much from *B. muricata*, *B. serricauda*, and numerous other allied species.

Head with the sides rounded, and the crown convex; pale, with three broad dusky stripes. Thorax smooth, dingy-brown. Abdomen with the seventh and eighth dorsal segments much shorter than the sixth, but not broader; or if they appear broader, this is owing to their being flattened out by the bulk of the sexual organs beneath them. The terminal segment is about half the length of the penultimate, and very much narrower; its sides are bisinuate or waved, and its narrow apical part has thickened margins and on its upper surface two elongated depressions, the apical edge itself being excised in the middle and having its angles very obtuse. The anal styles are short, straight, and abruptly thickened at the end, and they are pendent beneath the apical segment. The legs are slender and unarmed; the tarsi, especially the posterior, are much lengthened, and the basal joint is long and simple.

Hab. Two examples, taken at Ega, Upper Amazons. One of them is rather smaller than the other, and has the intermediate legs shorter in proportion. The two specimens, however, agree precisely in the apical segments of the abdomen and their appendages—a fact which shows that these offer more reliable specific characters than the legs.

Bacteria comis, n. sp. *Mas. B.* filiformis, gracillima, omnino inermis, luteo-viridis, antennis pedibusque pubescentibus; capite oblongo, supra plano, postice paulo attenuato, oculis convexis; abdominis segmento penultimo dorsali haud dilatato, lateribus deflexis; segmento ultimo (longitudine præcedenti æquali) postice subattenuato, angulis rotundatis, apice leviter emarginato; stylis analibus brevibus, simplicibus; pedibus parum elongatis.—Long. corp. 3″ 5‴; anten. 2″ 5‴; capit. 1¾‴; prothor. 1⅓‴; mesoth. 10‴; metath. 7½‴; abdom. 1″ 8½‴ (Pl. XLIV. f. 12 *b*.)

Bacteria comis differs from most of the other South American species in the shape of the head, which, in the male, is oblong instead of suborbicular; in this respect it resembles *B. molita*, but it is well distinguished from this by its much larger size, and by the apical dorsal segment being narrow and attenuated instead of inflated on the sides.

Head oblong, slightly narrowed behind, above plane, unarmed; eyes large and prominent. Antennæ pubescent. Body slender, cylindrical, smooth and shining, quite free from spines or tubercles, yellowish green, in life doubtless of a grassy-green hue. Thorax not dilated at the insertion of the legs. Abdomen rather slenderer than the thorax; three terminal dorsal segments of nearly equal length; penultimate scarcely dilated towards the tip, sides deflexed; apical segment attenuated posteriorly, apical edge faintly notched in the middle, angles rounded; anal styles short and filiform. Legs less elongated than usual in *Bacteria* (fore leg 2″ 3‴, hind leg 2″ 6‴), pubescent, unarmed; tarsi with the basal joint elongated, simple.

Hab. One example, received from Bogotá.

Bacteria serricauda, n. sp. *Mas. B.* tenuissima, omnino inermis, olivacea, antennis abdomine pedibusque pilis brevibus erectis dense vestitis; capite convexo, suborbiculari; abdominis segmento penultimo dorsali parum dilatato, lateribus rectis deflexis; segmento ultimo basi constricto, marginibus multidenticulatis, apice leviter emarginato; stylis analibus sensim clavatis, subrectis, apice subtruncatis; pedibus gracillimis, tarsorum articulo primo compresso latiusculo haud cristato.—Long. corp. 4″ 6‴; anten. 3″ (?); mesoth. 1″ 1‴; metath. 9½‴; abdom. 2″ 3½‴. (Pl. XLIV. f. 13 *a*.)

This species is closely allied to *B. Emesa*, Westw. (Cat. Phasm. plate v. fig. 3), having the same slender form, and nearly the same proportions of the different parts of the body; it differs, however, in the shape of the apical dorsal segment and the anal styles.

Head convex above, much wider than the prothorax, unarmed. Antennæ pubescent (apex wanting). Body unarmed, of an olivaceous hue. Thorax smooth, naked, scarcely dilated at the insertion of the legs. Abdomen clothed with short hairs similar to those on the antennæ and legs; the three apical dorsal segments nearly equal in length, scarcely dilated, the seventh slightly so at the apex, the eighth more so, but the sides deflexed and the angles rounded; the apical segment excised on each side at the base for the passage of the anal styles (which are rather long, pendent, gradually clavate to the apex, and obtusely truncated), the rest of its margin distinctly and evenly serrated, and its apex slightly emarginated. Legs elongated and simple; basal joint of all the tarsi strongly compressed along its whole length, not crested.

Hab. One example, Ega, Upper Amazons.

Bacteria culmus, n. sp. *Mas. B.* cylindrica, tenuissima, viridis; pedibus omnibus inermibus, valde elongatis, longitudine fere æqualibus; capite suborbiculari, vertice bicorni; abdominis segmento dorsali ultimo præcedente longiore.—Long. corp. 5″; anten. 4″; mesothor. 1″ 3‴; metathor. 11‴; abdom. 2″ 6‴.

Male. Extremely slender, filiform, and wholly of a grassy-green hue. Head nearly globular, the vertex with two moderately long, acute and stout spines, which are nearly erect, being curved only in a slight degree forwards. Thorax wholly smooth and simple, the proportion of the mesothorax to the metathorax being the same as in the other South American species of this group—namely, about as 4 : 3. The abdomen has the seventh and eighth segments about half the length of the sixth; but the ninth, or apical segment, is somewhat longer than the two preceding, and, like them, is of the same width as the rest of the abdomen, except at the tip, where it is somewhat widened, the terminal angles being very much rounded, and the middle of the margin being sinuated. The anal styles are small, and wholly concealed under the apical segments. The apical ventral segments are elongated, and only moderately convex beneath, the tip reaching to the base of the terminal dorsal segment. The legs are all greatly elongated and simple, the intermediate pair being very little shorter than the front and hind pair. The basal joint of the tarsi is excessively elongated, being about double the length of the remaining joints taken together.

Hab. One example, from Brazil.

BACTERIA SAKAI, n. sp. *B.* cylindrica, fusco-grisea, capite pedibusque inermibus, corpore albo minute granulato, thoracis lateribus sparse denticulatis, mesonoto spinis majoribus acutis armatis (*fœm.*)—Long. corp. 6″ 4‴–7″; anten. 3″ 3‴; mesothor. 1″ 9‴; metath. 1″ 1‴; abdom. 3″ 6‴. (Pl. XLIV. f. 1.)

Head oval, scarcely convex, unarmed; mesonotum furnished with short scattered spines, a few of those on the middle portion being larger than the rest and stouter, but sharply pointed; mesonotum unarmed above, having only a few short denticulations on the sides. Abdomen cylindrical to the apex, the fourth dorsal segment having in the middle of its apical margin a small tubercle; the apical segment is rather longer than the preceding, and is sinuated on its front margin, with the lateral angles very obtuse. Anal styles inconspicuous. Sixth ventral segment narrowed and bifid at the tip. Vaginal operculum surpassing (by a length of about two lines) the tip of the abdomen, scarcely convex, obtuse at its apex; sides of the penultimate ventral segment visible, the hind angles being greatly elongated and deflexed. Legs moderately stout, basal joint of the tarsi scarcely longer than the three following united, compressed and crested. The whole body is covered with very small whitish granulations, most conspicuous on the underside of the thorax; its colour is dingy-greenish or brownish-grey.

Hab. Two examples, taken at Ega, Upper Amazons. The male of this species would be closely allied to *B. muricata* (Burm.). I have given to the insect the name which it bears amongst the Indians, namely *Sakai,* a twig or stem.

LONCHODES DOREYANUS, n. sp. *Mas.* Gracilis, cylindricus, viridis; capite bispinoso; antennis longis, setaceis; prothorace antice bi-, postice unispinoso; mesothorace postice trispinoso, medio spinoso vel inermi variabili; metathorace 4- vel 6- vel 8-spinoso; abdominis segmentis 4 anticis maris unispinosis, feminæ 3-spinosis; femoribus apice infra bidenticulatis; abdominis segmento terminali dorsali inciso, ventrali modice inflato.—Long. corp. 1″ 3‴; mesothor. 5¾‴; metath. 3‴.

Fœmina. Robustior, corporis latitudine inæquali; femoribus fusco maculatis, quatuor posticis supra dentatis, omnibus apice infra denticulatis; abdomine thorace latiore, pone medium paulo constricto, segmento dorsali septimo postice elevato-tuberculato, ultimo rostriformi horizontali; operculo elongato, attenuato.—Long. corp. 2″ 8‴; mesothor. 7‴; metath. 3½‴; segmenti termin. dors. 2½‴; operc. 4½‴.

This species resembles much *L. Wallacei* (*Acanthoderus id.*, Westw.), differing chiefly in the presence of two spines on the head, and in the short and horizontal form of the terminal segment of the abdomen in the female. The females of the two species, however, differ greatly in size and in the armature of abdomen and thorax. The number of the thoracic spines varies considerably, but the cephalic spines are constant in all the four examples which I have examined. I place this and the allied species in the genus *Lonchodes* on account of the general form, antennæ, and cleft apical segment of the males agreeing well with the rest of the numerous species forming the genus. The shape of the apical segment of the abdomen in the females seems to point to a connexion between *Lonchodes* and *Heteropteryx*.

Hab. Dorey, New Guinea (*Wallace*).

There are four examples in Mr. Saunders's collection, two of which are ticketed as having been taken *in copulâ*. The male in this pair has the middle part of the mesothorax quite smooth and unarmed, whilst the same portion of the segment in its partner has two transverse rows of spines, four in each row. A second specimen of the male agrees in all respects with the one just mentioned, except in the number of the thoracic spines—the middle part of the mesothorax having two pairs, placed in the same position as those of the female.

LONCHODES HISPA, n. sp. *Mas.* Gracilis, cylindricus, viridis; capite bispinoso; antennis longis, setaceis; prothorace antice bi-, postice unispinoso; mesothorace medio 4- vel 6-, postice 5-spinoso; metathorace 6-, 8- vel 10-spinoso; abdominis segmentis quatuor primis trispinosis, quinto unispinoso; femoribus apice infra denticulatis. Variat femoribus apice nigris.—Long. corp. 2″ 1‴; mesothor. 7‴; metath. 3½‴.

Lonchodes Hispa has a close resemblance to *L. Doreyanus*, differing chiefly in the four basal segments of the abdomen having each three spines instead of one. Unfortunately the female sex is at present unknown, so that it is difficult to decide whether it is a mere variety of *L. Doreyanus* or a distinct form.

The spines are longer than in the males of either *L. Doreyanus* or *L. Wallacei*; the anterior division of the metathorax has near the hind margin three spines, and the posterior division also normally three; but in one example the lateral ones are small, and in a third obsolete; the sides of the metathorax have each either one or two spines; so that the total number on this segment of the body varies from six to ten. The coxæ have all a distinct, acute spine. The apical dorsal segment of the abdomen is of the same shape as in the two allied species; the central line of the three terminal dorsal segments is strongly elevated.

Hab. There are three examples in Mr. Saunders's collection—namely, one from the island of Salwatty, and two from New Guinea.

LONCHODES FLAVICORNIS, n. sp. *Mas.* Gracilis, cylindricus, corpore tenuissime transverse ruguloso, leviter granulato, subnitido, castaneo-olivaceo; capite oblongo, inter oculos acute bispinoso; antennis setaceis, dimidio basali nigro, apicali pallide flavo; thorace inermi; abdomine cylindrico, segmentis 7° et 8° sexto vix minoribus, 9° elongato attenuato profunde fisso; pedibus gracilibus, inermibus, tarsis simplicibus. —Long. corp. 2″ 4‴; anten. 2″; mesothor. 7½‴; metath. 5‴; abdom. segm. prim. 10‴+3‴ terminal. 3½‴=1″ 4½‴.

Closely allied to *L. Praon* and *L. pseudoporus* (Westw.), but differing greatly in the shape and proportions of the terminal segments of the abdomen. A large number of specimens arrived in the same collection from Ceylon, with a number of females of *L. cyllabacus* (Westw.), unaccompanied by examples that could be taken without doubt as the opposite sexes of the two species; so that it is possible, notwithstanding the total want of resemblance in the armature of the legs, that *L. flavicornis* may be the male of *L. cyllabacus*.

The body is slender, cylindrical, and shining; it is finely sculptured throughout, however, with transverse striæ visible with a lens of small magnifying power; and the thorax is sparingly granulated. The antennæ in all the examples before me (four) have the apical halves of a pale yellow colour. The seventh segment of the abdomen is very little shorter or broader than the sixth; the eighth is of nearly the same dimensions as the seventh; the ninth or terminal segment is almost as long as the two preceding taken together, and is narrowed behind, with the apex cleft to less than half the length of the segment; the two lobes formed by the fissure, however, are not straight, but curved, forceps-like, and finely denticulated on their inner side. The legs are unarmed and slender.

Hab. Ceylon (*Nietner*). There are four examples, precisely agreeing, in Mr. Saunders's collection.

Lonchodes grallator, n. sp. *Mas.* Elongatus, gracilis, lævis, nitidus, omnino inermis, viridis; pedibus elongatis, gracilibus, flavis, geniculis tibiarumque apicibus nigris; capite oblongo, haud convexo, postice paulo attenuato; antennis modice curtis, filiformibus; abdominis segmento terminali duobus præcedentibus conjunctis longiore, recto, postice attenuato, usque ad basin (spatio brevi excepto) fisso.—Long. corp. 3″ 4‴; anten. 1″ 2‴; mesothor. 10‴; metath. 7½‴; abdom. art. ultim. 2¼‴; ped. ant. 3″ 9‴, intermed. 2″ 5‴, post. 3‴.

Allied to *L. Stilpnus* (Westw.) and *L. nematodes* (De Haan), with which species *L. grallator* agrees in the short, filiform antennæ. It differs, however, from *L. Stilpnus* in the unarmed condition of its legs, and from *L. nematodes* in the oblong form of its head.

The body and limbs are entirely smooth and unarmed. The antennæ are quite thread-shaped, or of equal and moderate thickness throughout. The seventh and eighth abdominal segments are a little wider than the rest of the abdomen, and are no longer, taken together, than the sixth. The terminal segment is much elongated and attenuated behind; it is cleft nearly to the base; the two lobes are quite straight, and have each a series of denticulations on their inner side; but their basal parts are deflexed, and meet on the underside, protecting the slender anal styles, which are far from reaching the apex of the abdomen. The apical ventral segment is conically inflated. The legs are very slender, and wholly unarmed. In the dead specimen they are of a yellow colour, with the knees and tips of the tibiæ black. The tarsi are greatly elongated and filiform.

Hab. Ceylon (*Nietner*), one example. Coll. W. W. Saunders, Esq.

Lonchodes auscultator, n. sp. *Mas.* Elongatissimus, gracilis, parce verrucosus, virescens; capite subquadrato, postice paulo attenuato, supra processis duobus auriformibus magnis armato; oculis magnis; antennis elongatis, filiformibus; abdominis segmento terminali reliquis latiore, medio emarginato, lateribus paulo divergentibus; pedibus modice elongatis, elevato-lineatis, femoribus intermediis supra tibiisque infra spina brevi foliacea armatis.—Long. corp. 3″ 11‴; anten. 2″ 9‴; mesothor. 11‴; metath. 9¼‴; ped. antic. 3″ 1‴, intermed. 2″, post. 2″ 10‴.

The insect is almost as slender in body as the *L. nematodes* (De Haan); but the legs are very much shorter, thicker, and more ridged than in that or any of the allied species; the shape of the terminal segment of the abdomen also distinguishes it from these and other members of the genus. The ear-shaped cephalic processes resemble those of *Lonchodes Taprobanæ*, to which our species also approximates in the form of the legs; it differs, however, from the male of *L. Taprobanæ*, as figured by Professor Westwood, in the shape of the apical abdominal segment.

The colour is probably green in life, varied on the legs and antennæ with spots of a darker hue. The antennæ are very long, but filiform rather than setaceous in shape. The body has a number of small round warts scattered over its surface. The abdomen is as narrow as the thorax from the base to the end of the sixth segment; the seventh widens from base to apex, and is only half the length of the sixth; the eighth is somewhat shorter; but the ninth is longer than either of them, and, instead of tapering to the end as in the allied species, becomes broader; it is broadly notched in the middle, and the two sides are somewhat divergent, with their apices broad and sinuated. The anal styles are short and concealed; the terminal ventral segment reaches the tip of the eighth dorsal, and is much smaller. The raised lines of the legs, near the middle of the intermediate femora above and the tibiæ of the same legs beneath, are expanded into very short compressed spines; with this exception the legs are unarmed; the basal joints of the tarsi are only moderately elongated, and in the anterior feet are compressed.

Hab. Ceylon (*Nietner*). One example, in the collection of W. W. Saunders, Esq.

Lonchodes furcatus, n. sp. *Mas et fœm.* Cylindricus, granulatus, obscure fuscus; capite oblongo, inter oculos bispinoso; antennis longis, setaceis, articulo basali complanato; abdominis segmento terminali furcato.

Mas. Minor gracilis; thorace parce granulato; abdomine longitudinaliter elevato-lineato, segmento apicali ventrali tumido; pedibus modice elongatis, subcompressis, valde elevato-lineatis.—Long. corp. 1″ 11‴; anten. 1″ 2‴; mesothor. 6‴; metath. 4½‴; ped. antic. 1″ 2½‴, intermed. 11‴, post. 1″ 1½‴. (Pl. XLIV. f. 6.)

Fœm. Major, robustior; thorace dense acute tuberculato; abdomine aspere granulato; capitis spinis longis, validis, acutis; femoribus intermediis supra prope basin lobo magno foliaceo rotundato.—Long. corp. 3″ 5‴; anten. 2″ 4‴; mesothor. 9¼‴; metath. 6¼‴; ped. ant. 2″ 8‴, ped. intermed. 1″ 11‴, ped. post. 2″ 3½‴. (Pl. XLIV. f. 5.)

This species is readily distinguished by the forked shape of the terminal abdominal segment in both sexes. This structure seems to result from the fissure of the apex of the segment being very wide, and the sides diverging slightly, each forming a lobe of equal breadth from base to apex, with the sides strongly deflexed. The anal styles are short, and visible only underneath the entire base of the forked apical segment. The operculum of the female is of the ordinary, convex, keeled shape, and reaches to the base of the fork. The thorax of the female is thickly covered with sharp tubercles both above and beneath. The cephalic spines are much smaller in the male than in the female. The legs are unarmed in the male, and also in the female with the exception of a large foliaceous lobe on the upper side of the intermediate femora near the base. The tarsi are simple, but compressed.

Hab. Ceylon (*Nietner*). Two examples in the collection of W. W. Saunders, Esq.

Lonchodes denticauda, n. sp. *Mas.* Gracilis, cylindricus, obscure viridi-fuscus, granulatus; capite oblongo, inter oculos bispinoso; antennis setaceis, pallidis, nigro annulatis; abdomine apicem versus longitudinaliter sulcato, segmento terminali apice medio inciso, lateribus utrinque apice excavato, angulo inferiore producto intus valde dentato; pedibus modice elongatis, gracilibus, inermibus.—Long. corp. 2″; anten. 1″ 4‴; mesothor. 6‴; metath. 4¼‴.

The peculiar form of the terminal abdominal segment amply distinguishes this species from its congeners. The abdomen towards its apex is longitudinally furrowed and wrinkled; the seventh and eighth segments are not much shorter or apparently broader than the sixth; the terminal segment is a little longer than either of the two preceding, it is not attenuated behind, and is cleft as usual in the middle, but each lobe at its vertical apex is emarginated, and the lower edge is much produced and armed on its inner side with a row of conspicuous teeth. The slightly convex and rugose apical ventral segment reaches barely to the apex of the eighth dorsal.

Hab. Ceylon (*Nietner*). One example in the collection of W. W. Saunders, Esq.

Lonchodes personatus, n. sp. *Fœmina.* Elongatus, cylindricus, granulatus, opacus, cinereo-ochraceus, corpore fusco lineato, pedibus nebulosis; capite subquadrato, leviter convexo, aspere granulato, inter oculos spinis brevissimis duabus; antennis elongatis, setaceis; abdomine ruguloso; operculo convexo, declivitate postica valde dentata; pedibus brevibus, femoribus omnibus apice infra dentatis, tibiis anticis dilatatis, femoribus intermediis supra spinis foliaceis magnis, tarsorum anticorum articulo basali elevato-compresso.—Long. corp. 5″ 2‴; anten. 2″; mesothor. 1″ 2‴; metath. 10‴; ped. ant. 2″ 3‴, intermed. 1″ 7‴, post. 2″. (Pl. XLIV. f. 7.)

This fine species so nearly resembles Stoll's figure of *Phasma femoratum* (*Prisomera femorata*, Westw.), an Amboyna insect, which appears not to have been met with since the time of the early Dutch naturalists, that I have some hesitation in giving it a new name. It differs in the form and number of the foliated spines of the upper surface of the middle femora; but the amount of difference in this respect would be scarcely sufficient to warrant the step I have taken, if the figure and description of Stoll did not leave us in the dark as to several other important features which, if absent from his specimen, as we might conclude from their not being mentioned, would show that we have to deal with a totally distinct species. These features are the granulated surface of the body and the curious dentated posterior slope of the operculum. Even should Stoll's species possess these characters, it would perhaps still be necessary, on account of the different armature of the middle femora, to distinguish ours as a local form—it being an inhabitant of the island of Bourou, while *Phasma femoratum*, as before mentioned, is a native of Amboyna.

The body is cylindrical and granulated throughout, with numerous longitudinal wrinkles on the surface of the abdomen. It is of a dingy-ochreous hue, with irregular dusky stripes, and is quite without lustre. The head is subquadrate and slightly convex, and there are two short, widely-separated spines between the eyes. The seventh abdominal segment is shorter than the sixth, but much longer than either of the two following, which are about equal in length, the apical segment has its terminal margin trisinuate, with the angles prominent. The operculum is a little longer than the dorsal tip of the abdomen, and has a very distinct keel, the posterior half of which is cleft, leaving a number of tooth-like projections; the sides of the posterior slope are also dentated. The legs are short and stout; all the femora have numerous teeth near the apex on the under surface; the anterior pair have also a row of short, compressed, and rounded expansions of membrane along their upper surface, and the middle femora have each, along the apical half, five or six larger, compressed, and obtuse spines. The anterior tibiæ are equally and broadly dilated throughout, the middle tibiæ are a little widened at the base and apex; the hind tibiæ have a broad and short foliated tooth near the base on the inner side. The tarsi are short, the basal joints being scarcely so long as the second and third taken together, and in the anterior feet are elevated and compressed.

Hab. Island of Bourou, Malay archipelago (*Wallace*). Coll. W. W. Saunders, Esq.

LONCHODES PHALANGODES. *Mas. L.* tenuissimus, inermis, pedibus elongatissimis, rectis, linearibus; abdominis segmento dorsali apicali usque ad basin fisso. Long. corp. 4″ 2‴; mesothor. 11‴; metath. 10‴; ped. anticis 5″ 2‴; ped. intermed. 3″ 6‴; ped. poster. 4″.

Closely allied to *L. nematodes* of De Haan; but the body is rather stouter, and the apical dorsal segment differs in shape.

Head oval (mutilated, and antennæ wanting). Fore legs excessively elongated, being an inch longer than the body, and quite linear, the base of the femora not being curved as it generally is in this family; fore tarsi nearly ¾ of an inch in length. Thorax entirely smooth. Abdomen smooth; seventh and eighth segments taken together about equal in length to the sixth, and not much longer than the ninth, which is cleft to the base, the cleft not suddenly gaping towards the apex, the tips of each lobe being denticulated, and the anal styles short and incurved. The seventh and eighth segments are dilated, but the dilated margins are deflexed, the eighth at the tip nearly, and the base of the ninth quite, meeting beneath, the apical ventral segments being much abbreviated, and not reaching the tip of the eighth dorsal segment. Legs all quite simple and linear.

Hab. One example, from Batchian (*Wallace*).

LONCHODES DISPAR, n. sp. *L.* cylindricus, elongatus, tenuis, granulosus, luteus, olivaceo, varius; capite breviter bispinoso; pedibus anticis elongatis, tenuibus, intermediis brevibus, posticis paullo elongatis, femoribus omnibus apicem versus infra denticulatis; abdominis segmento ultimo dorsali valde elongato et postice attenuato (*mas*).—Long. corp. 3″ 7‴; mesothor. 1″; metath. 9‴; abdom. 1″ 8‴.

This species is nearly allied to *L. uniformis* (Westw. Cab. Or. Ent. plate 39. fig. 3); but it is much more slender, and the apical dorsal segment is much longer, and cleft in a somewhat different manner. It resembles still more closely *L. Trollius* (Westw. Cat. Phasm. plate xxiii. fig. 1); but *L. Trollius* has the apical segment cleft to its base, whilst the fissure extends in *L. dispar* only a short way from the apex.

Body slender, cylindrical, densely and finely granulated thoughout; the colour is green, in some parts luteous, with the tips of the thighs red. Head elongate, being much prolonged behind the eyes, flattened above, and with prominent hind angles, the forehead, between the eyes, having two short but acute spines directed forwards. Antennæ two-thirds the length of the body. Thorax unarmed, mesothorax enlarged at the insertion of the legs, metathorax not so; the latter is strongly bowed. Abdomen with the seventh and eighth dorsal segments dilated; taken together they exceed the sixth in length; the terminal segment is nearly equal in length to the two preceding, and is gradually narrowed behind to a point, the apex being cleft, and the two lobes slightly incurved and toothed on their inner margins; anal styles short and inconspicuous. Fore legs slender, 2″ 3‴ in length; middle legs shortened and thickened, especially the thighs, 1″ 4‴ long; hind legs of the same thickness as the front pair, but 3‴ shorter. The tarsi are all short, with the upper apical angles of the joints much produced, the basal joint in the middle and hind tarsi being no longer than the two preceding taken together, in the fore tarsi much longer. All the thighs have a small cluster of denticulations beneath near their apex, those of the middle thighs being larger than the rest.

Hab, One example, taken by Mr. Wallace at Sarawak, Borneo.

LONCHODES FORCIPATUS, n. sp. *L.* cylindricus, modice elongatus, robustus, confertim granulatus, luteo-olivaceus, pedibus viridibus, femoribus apice luteis; abdominis apice clavato, segmento ultimo fisso, ramulis instar forcipis incurvatis (*mas*).—Long. corp. 2″ 6‴; mesotho. 7½‴; metatho. 6½‴; abdom. 1″ 1‴; anten. 1″ 6‴.

Resembles *L. geniculatus* of Gray (Westw. Cab. Or. Ent. plate 39, fig. 4), but differs from that species in being much stouter, with (in proportion) shorter antennæ, and in the apical dorsal segment being cleft nearly to the base, with the two lobes thus formed narrowed each to a claw-like point, and curved.

Head quadrate, slightly narrowed behind eyes, and flattish beneath, unarmed, closely covered like the rest of the body, above and beneath, with minute and smooth, rounded tubercles. Thorax longer than the abdomen, greatly enlarged at the insertion of the legs, the metathorax, in addition, being gibbous above at that point; the metathorax is also wider than the mesothorax. Abdomen cylindrical like the thorax, but narrower, the three terminal segments forming a club, the seventh and eighth being greatly dilated, and the ninth, which is much the longest of the three, deflexed, cleft in the middle, with the two lobes curved and sharply pointed, with a series of sharp teeth on the inner side of each. The anal styles are short, straight, and obtusely pointed; the apical ventral segments are gibbous beneath. The legs are rather short and stout the femora somewhat thickened and each armed, near the apex, beneath with a cluster of small and sharp teeth; the basal joint of the tarsi is scarcely longer than the three following taken together. The colour of the body is fulvous-brown, with an olive tinge; the legs (even in dried specimens) are of a fine green hue, with the knees orange-yellow.

Hab. Of this handsome, well-proportioned species there are two examples, one from Menado, and one from Tondano, in the North of Celebes, taken by Mr. Wallace.

LONCHODES ASPERATUS, n. sp. Robustus, sordide olivaceo-luteus, opacus, corpore toto rugulis longitudinalibus, granulis et tuberculis acutis asperato; capite quadrato, postice haud attenuato, inter oculos breviter bispinoso, antennis articulo basali lato complanato; pedibus validis, femoribus apice anticis uni-, intermediis et posticis quadrispinosis; tarsis simplicibus.

Mas. Cylindricus, tuberculis parvis minus acutis; corpore supra coxas dilatato; abdomine segmentis 7° et 8° paulo abbreviatis et dilatatis, 9° attenuato profunde fisso, fissura intus denticulata; segmentis genitalibus nodulosis, medio carinatis, apice subacuto; stylis analibus brevibus, complanatis, obtusis.—Long. corp. 2″ 2‴; anten. 1″ 6‴ (circa); mesothor. 6‴; metath. 4‴; ped. post. $10\frac{1}{2}$‴.

Fœm. Major, latior, subcylindricus, tuberculis majoribus subspinosis; abdomine segmentis dorsalibus 6°–8^{m} apice dentatis, ultimo apice dilatato, medio valde emarginato; segmento ventrali sexto apice producto, lobato; operculo medio tumido, usque ad apicem segmenti ultimi dorsalis extenso.—Long. corp. 2″ 9‴—3″ 3‴; anten. 2″.

The male of this species resembles *L. Myrina*, Westw. (Cat. Phasm. t. xxiv. fig. 7), agreeing with that species in the form, and pretty nearly in the proportions of the apical segments of the abdomen, both ventral and dorsal, and in the spines at the apex of the femora; but it is shorter, much more robust, and differs entirely in having coarse wrinkled integuments studded with small tubercles and granulations. The head is short and thick, and not narrowed behind; and is armed in both sexes, between the eyes, with two short spines. The basal joint of the antennæ is broad and flattened, like that of many species of *Bacillus* and *Acanthoderus*. The proportion of mesothorax to metathorax is as three to two in both sexes, and the granulations and wrinkles of the body are moderate in the male, but strongly pronounced in the female, the former amounting in some examples to short and acute spines. The legs are stout and somewhat short, the hind pair, when stretched out, surpassing by but little the length of the abdomen, and the middle pair are in due proportion. The apical dorsal segment of the abdomen in the female is dilated at each apical angle, and deeply emarginated in the middle, the emargination being occupied by a supplementary tenth segment. A distinguishing character of the species, as far as this sex is concerned, is the remarkable compressed lobe into which the apical part of the sixth ventral segment is produced.

Hab. Darjeeling; from Mr. Russell's Collection. One male and two females in Mr. Saunders's Collection.

LONCHODES RUSSELLII. *Mas.* Cylindricus, elongatissimus, obscuro-viridis, glaber, subnitidus; capite oblongo-quadrato, postice leniter attenuato; antennis articulo basali haud dilatato; abdomine segmentis 7° et 8° paulo abbreviatis, segmento ultimo tertia parte apicali fissa, segmento terminali ventrali paulo convexo, lævi, segmentum 8^{m} dorsale vix superante; pedibus modice elongatis, femoribus intermediis et posticis apice quinque-denticulatis, denticulis linea unica ordinatis; tarsis filiformibus.—Long. corp. 4″ 3‴; mesothor. 10¾‴; metath. 9½‴; ped. post. 3″; abdom. 1″ 10‴+6‴=2″ 4‴.

Differs from *L. nematodes*, De Haan (Westw. Cat. Phasm. t. v. fig. 7), which it resembles in the extent of fissure of the terminal abdominal segment, in the elongato-quadrangular shape of the head, in the body and limbs being very much less attenuated: the general colour is dark-green or olive-brown, and the body is smooth throughout and shining. The antennæ are broken in the specimen described; the basal joint is of ordinary thickness. The legs are unarmed, except a single row of small denticulations underneath the middle and posterior femora towards the apex. The seventh and eighth dorsal segments are not notably abbreviated; taken together they are considerably longer than the sixth; the apical segment is a little shorter than the sixth, tapering, and the fissure extends scarcely to one third the length; the sides of the basal part coalesce beneath; the anal styles are short and pendent beneath the middle of the segment. The apical ventral segment is smooth, slightly convex, and reaches the apex of the eighth dorsal segment; the seventh and eighth ventral segments are simple.

Hab. Darjeeling: one example, male, from Mr. Russell's Collection (Coll. of W. W. Saunders, Esq.).

PHIBALOSOMA EXTENSUM, n. sp. *Ph.* magnum, cylindricum, attenuatum, corpore lævi; capite cornibus duobus rotundato-foliaceis armato; operculo vaginali longissime canaliculato, apice sinuato-truncato, longe ultra apicem in linea recta extenso; pedibus mediocribus, foliaceo-spinosis (*fœm.*).—Long. corp. (operc. inclus.) 7″ 7‴; mesothor. 1″ 6‴; metath. 1″ 3‴; abdom. 3″ 8‴; operculi 8‴.

Body moderately slender, cylindrical, dingy-brown sprinkled with white. Head slightly convex, vertex, between the eyes, armed with two oval leaf-like horns. Antennæ long, setaceous (apex wanting). Thorax and abdomen unarmed. Abdomen with the three apical joints, taken together, rather shorter than the sixth; a small pointed segment appearing at the tip of the ninth. Anal styles rather short. Vaginal operculum scoop-shaped, keeled beneath, sinuato-truncate at the apex, surpassing the dorsal apex of the abdomen by a length of 8 lines, and unaccompanied by filaments. Fore legs not much longer than the second pair; fore femora beneath with three tooth-like expansions—namely, one before the middle, the second beyond the middle, the third at the apex; fore tibiæ with three rounded expansions beneath, in nearly the same relative positions as those of the femora. Middle femora with four large tooth-like expansions near the base—namely, two above, approximated, and two wide apart beneath; middle tibiæ with a pair of similar expansions on the upper surface near the base, and a single one in the same line beyond the middle. Hind femora with numerous tooth-like spines placed wide apart from base to apex; hind tibiæ with two or three similar processes on the upper surface. Tarsi moderately elongated, basal joint simple, as long as the remaining four taken together.

This fine species resembles greatly *Phibalosoma phyllocephalum* (Westw. Cat. Phasm. plate xxxiii. fig. 1), differing in its unarmed body and in the shape of the vaginal operculum. There is one example only, without locality.

PHIBALOSOMA MAXIMUM, n. sp. *Ph.* longissimum, cylindricum, corpore lævi, abdominis segmento ventrali sexto apice longe bidentato, segmento dorsali apicali valde sinuato; pedibus spinosis (*fœm.*).—Long. corp. 10″; mesothor. 2″ 3‴; metath. 1″ 7‴; abdom. 5″ 6‴.

Closely allied to *Phibalosoma acanthopus*, Burm., but differing in the sinuation of the tip of the apical dorsal segment, and the existence of two tooth-shaped processes at the apex of the sixth ventral segment instead of a simple spine.

Head oblong, smooth, crown oblique, the occiput projecting behind in a conical but obtuse elevation. Antennæ slender and elongated. Thorax and abdomen cylindrical, smooth; the apex of the sixth ventral segment armed with two rather long tooth-shaped corneous processes, placed close together; the terminal dorsal segment deeply and widely notched. The seventh dorsal segment is a little shorter than the sixth, and more than twice the length of the eighth and ninth taken together. The vaginal operculum is boat-shaped and keeled, with its tip rounded, and reaching the apex of the last dorsal segment, the membrane between the operculum and the apical dorsal segment has two corneous appendages, one of them greatly elongated, narrow, and curved, the other short and broad. The anal styles are short, straight, and pointed. The fore legs are moderately long (7″ 2‴), the femora being serrated along their upper and lower edges, and the tibiæ faintly denticulated; the middle femora are strongly denticulated, with a large foliaceous spine on their upper edge towards the base, the middle and posterior tibiæ (also denticulated) have a similar flattened spine in the middle of their upper edges, whilst the hind femora are simply denticulated. The basal joint of all the tarsi is greatly elongated, with the upper edge raised, compressed, and foliaceous at the tip.

Hab. Taken in Sumatra by Mr. Wallace. It is probable that this may be the female of *Ph. serratipes*, Gray.

PHIBALOSOMA CALAMETUM. *Fœm.* Cylindricum, glabrum; capite fusco, lateribus albo late vittatis, subquadrato, postice subsinuato-attenuato, inter oculos spinis duabus brevibus approximatis, occipite bituberculato; oculis valde prominentibus; thorace abdomineque inermibus; operculo elongatissimo, lineari, supra concavo, apice truncato; stylis brevibus, acutis; pedibus validis, femoribus et tibiis acanthophyllis, tarsis anticis articulis tribus apice extrorsum lobatis.—Long. corp. 7″ 3‴+operculo 1″= 8″ 3‴; anten. 4″; mesothor. 1″ 7‴; metath. 1″ 3‴; ped. antic. 4″ 4‴; ped. post. 4″ 2‴.

Distinct in the shape of the head from the allied species, this member being cuboidal in shape, narrowed behind the eyes, and slightly widened again at the posterior angles, which are obtuse; the eyes are very prominent, and there are two acute tubercles lying between the eyes and nearer together than frontal spines generally are in this family; there are, besides, two rounded tubercles above the slope of the occiput; the sides have each a broad, distinct, whitish vitta. The antennæ are elongate and setaceous, the base being thick, but not flattened and dilated. The thorax and abdomen are free from tubercles, the three apical dorsal segments of the latter, taken together, are equal in length to the sixth, and the extreme apex is somewhat narrowed and sinuated in the middle. The operculum is transformed into a scoop-shaped ovipositor projecting an inch beyond the dorsal tip of the abdomen, and is 1 inch and 7 lines in length altogether; the anal styles are very short, and taper to a point. The legs are short and strongly ridged, some of the ridges of the femora and tibiæ having on each joint one or two foliaceous spines; the tip of the anterior tibiæ and the tips of three basal joints of the tarsi are each produced externally into a rounded lobe.

Hab. Caffraria, taken by M. Gerrard (Coll. W. W. Saunders, Esq.). In the example described, the legs on the left side of the body are, as is often the case in Phasmidæ, reproduced limbs, and consequently much shorter and more feebly armed than those of the right side.

ACANTHODERUS MOUHOTII, n. sp. *Fœm.* Elongatus, subdepressus, obscurus, griseofuscus; capite oblongo, occipite linea elevata sex-dentata, vertice et fronte acute tuberculato; antennis brevibus, filiformibus, articulo primo lato extus tuberculato, angulo exteriore apicali spinoso; prothorace tuberculato-rugoso; mesothorace verrucoso, linea mediana elevata, lateribus sulcatis; metathorace lineis curvatis dorsalibus; abdomine supra inæquali, lateribus parallelis, linea duplici dorsali, segmentis tertio quartoque medio bituberculatis, penultimo postice valde elevato, terminali apice lato verrucoso; sterno tuberculato, metasterno paulo dilatato marginibus articulatis; pedibus brevibus, validis, sulcatis, femoribus posticis supra spinis foliaceis tribus.—Long. corp. $1\frac{1}{2}''$; anten. $4\frac{1}{4}'''$; mesothor. $3\frac{1}{2}'''$; metath. $2\frac{3}{4}'''$; lat. corp. $1\frac{3}{4}'''$.

Closely allied to *Acanthoderus Oileus*, Westw., an inhabitant of the island of Java, differing chiefly in the shape of the terminal dorsal segment of the abdomen and the armature of the hind thighs. The single example is a female pupa, as is the case with the only known specimen of *A. Oileus*; but the great similarity between the pupæ and adult insects in this genus renders the description of the one state applicable to the other.

Elongate, of nearly equal breadth throughout; dingy brown. Head oblong; occiput with a curved, slightly raised line bearing six or eight short spines or pointed tubercles; vertex and forehead rugose and armed with two lines of similar spines converging towards the occiput; eyes moderately prominent. Antennæ short, filiform; basal joint oblong, flattened, sides tuberculate, lateral anterior angle produced into a spine. Thorax rugose; pronotum warty; mesonotum with a raised dorsal line, a row of tubercles on each side, and two ridges with corresponding grooves running near to each lateral margin, hind edge in the middle with two obtuse tubercles; metanotum with two curved raised dorsal lines on each of its divisions. Abdomen a little narrower than the thorax, surface rough, the lateral portion of each segment with two oblique raised lines, the spaces between which are punctured, middle of each segment with two curved raised lines which, in the third and fourth, terminate in obtuse tubercles; penultimate segment elevated behind, apical segment broad at the tip, its surface separated from the sides by raised lines, sloping and tuberculated. Meso- and metasternum tuberculated, the sides near the coxæ dilated and obtusely denticulated. Legs short, stout, sulcated; hind femora above with three foliaceous spines.

Hab. One example, collected by the late M. Mouhot at Chantaboun, Camboja, is in Mr. W. W. Saunders's Collection.

Acanthoderus gravidus, n. sp. *A.* minus elongatus, crassiculus, rugosus, abdominis dimidio basali dilatato, tumido; cinereo-fusco unicolor; capite fronte breviter sexspinoso, occipite valde elevato et tuberculato; antennis brevibus, articulo basali margine exteriore bispinoso; thorace tuberculato; abdomine ultra partem elevatam valde depresso, deinde apicem versus paullo elevato, tuberculato, lateribus tuberculato-carinatis, segmentis 4^{o}–8^{m} medio carinato-dentatis (*fœm.*).—Long. corp. 1″ 11½‴; anten. 8‴; cap. 1½‴; prothor. 2‴; mesoth. 5‴; metath. 3‴; abdom. 1″.

Closely allied to *Pachymorpha coronata*, De Haan (*Acanthoderus id.*, Westw.), but differs in being almost uniformly tuberculated and destitute of the many prominent spines on the various parts of the body which *P. coronata* presents.

Body somewhat thick and broad, uniform light ashy-brown. Head not broader than the prothorax; forehead (above the antennæ) with six small but acute tubercles arranged in two rows converging upwards; behind these the occiput rises obliquely into an irregular conical mass studded with obtuse tubercles. The antennæ are short (as in the group to which *P. coronata* belongs), being little more than a third the length of the body and somewhat stout; the basal joint is of thick, irregular shape, but flattened above, and having two short teeth on its outer edge. Thorax nearly cylindrical, 10 lines in length and 3 in diameter, tuberculated throughout, the tubercles being more obtuse on the breast, two or more in the middle of the front and hind margins of the mesothorax and on the hind margin of the metathorax being larger than the rest; the keeled sides of the breast above the sockets of the legs have a row of small and rather more pointed tubercles. Abdomen with keeled lateral margins, the basal half dilated and elevated, the fifth and sixth segments much depressed, the rest rising again slightly to the apex; the lateral edges are obtusely denticulated, the surface is tuberculated, the fourth segment is strongly elevated in the middle, the elevation forming a double ridge gaping behind; the fifth to seventh segments have each a prominent tubercle in the middle; in the eighth this tubercle is expanded into a very prominent ridge; the apical angles of the segments are produced each into a tooth, the apical segment being strongly produced in the middle and faintly notched at the tip. Anal styles short, inconspicuous. Vaginal operculum convex, keeled, with its apical margin flattened out. Legs short, stout, femora of the middle and hind legs tuberculated above and beneath; tarsal joints very short; claw-joint about as long as all the rest taken together.

Hab. Island of Gilolo, Moluccas (*Wallace*).

Acanthoderus spiniventris, n. sp. Elongatus, subdepressus, cinereo-fuscus; capite oblongo, postice oblique elevato et spinoso, declivitate frontali usque ad basin antennarum lateribus spinosis; antennis brevibus, robustis, filiformibus, articulo basali extus trispinoso; pronoto quadrato, angulis spinosis, dorso acute tuberculato; mesonoto depresso, postice paulo ampliato, lateribus acute tuberculatis, dorso verrucoso, linea dorsali antice et postice bispinoso; metanoto mesonoto angustiore, quadrato, angulis posticis spinosis; metasterno lateribus dilatatis, denticulatis, medio spina magna; abdomine maris cylindrico, fœminæ pone medium constricto et depresso, supra verrucoso, segmentis 7 anterioribus supra bispinulosis, lateribus denticulatis et spina magna recta acuta armatis, 2 terminalibus angulatis, penultimo supra valide carinato, segmento quinto fœminæ nigro bimaculato; femoribus omnibus breviter spinosis.—*Mas* corpore angustiore; long. corp. 1″ 8‴; capit. 2‴; prothor. 1¾‴; mesoth. 4½‴; metath. 3″. *Fœm.* Corpore latiore; long. corp. 2″; anten. 9‴, 21-articulatis; cap. 3‴; prothor. 1¾‴; mesoth. 5‴; metath. 3½‴. (Pl. XLIV. f. 2 *a*, 2 *b*.)

Closely allied to *Acanthoderus coronatus* (De Haan), differing chiefly in the greater length and more pointed form of the lateral spines of the abdomen, which stand out at right angles to the body. Other minor points of difference are the much darker colour of *A. spiniventris* and the more enlarged form of the basal half of the abdomen in the female, followed by a greater constriction of the fifth and sixth segments.

Body of a dark ashy-brown colour; antennæ tawny at the tip. Head obliquely raised behind, the raised part armed with 5–7 acute tubercles or spines, and the frontal slope to the base of the antennæ armed on each side with similar spines, the middle of the forehead being tuberculated. Thorax flattened above, the outline widening from the front towards the middle of the mesonotum; surface warty, angles and dorsal line spiny; metasternum dilated on the sides and armed with a long straight acute spine. Abdomen of the male cylindrical, of the female dilated in its basal half, then greatly constricted, becoming dilated again towards the apex; surface in both sexes rough and warty, with a pair of sharp spines near the hind margin of each segment except the two terminal ones, the sides of the same denticulated and armed each with a long and very acute spine standing out at right angles to the body; eighth and ninth dorsal segments dilated and angulated, eighth with a high ridge in the middle, ninth narrowed towards the tip, tip notched. Legs stout, thighs armed with a few short spines.

Male. Body narrower than in the female; abdomen cylindrical, spotless; ninth ventral segment greatly enlarged and convex, tuberculated on the surface, and dilated on the sides.

Female. Body broad; fifth abdominal segment with two black spots in the middle of the base; operculum convex, keeled, tuberculated, reaching nearly the tip of the last dorsal segment.

A pupa of the female sex in Mr. Saunders's collection differs from the adult stage (besides the undeveloped state of the genital segment of the abdomen) only in the smaller size of the tubercles and spines, and in the absence of enlargement of the first four segments of the abdomen.

Hab. Islands of Timor and Bourou (Coll. W. W. Saunders, Esq.). Many examples were sent home by Mr. Wallace, and all agree in the essential features which distinguish the species from *A. coronatus.*

HETEROPTERYX WESTWOODII, n. sp. *Fœm.* Elongata, robusta, postice valde attenuata scabra et spinosa, cinereo-fusca; capite subquadrato, acute tuberculato, vertice mox pone oculos utrinque spinis duabus majoribus; pronoto valde inæquali, spinoso; mesonoto inæquali, scabroso et spinoso, lateribus valde spinosis; metathoracis lateribus spinosis; pectore plano, inermi; abdominis segmentis dorsalibus quatuor basalibus lateraliter acute tuberculatis, reliquis scabrosis, processu apicali elongato quam operculum breviore, apice subtruncato; operculo valde elongato, attenuato et curvato; pedibus validis, femoribus crassiusculis spinosis, tibiis apice paulo incrassatis; tegminibus quam alæ brevioribus, oblongis, prope basin supra valde elevatis et tuberculatis, ochraceis, fusco maculatis; alarum parte membranacea fusca, area costali ochracea fusco maculata.—Long. corp. 2″ 9‴; anten. 1″ 6‴; prothor. 3‴; mesoth. 3½‴; metath. 5‴; abdom. 1″ 4‴+process. apicali 3‴=1″ 7‴; opercul. 7½‴; expans. tegmin. 1″ 10‴, alar. 2″ 3‴.

This very distinct species of *Heteropteryx* differs from all others at present known by the length of the wings, which surpasses considerably that of the tegmina.

The general form of the insect is very similar to that of *H. Grayii* (Westw.) and *H. Mülleri* (De Haan); its colour is a dingy ochreous-brown, but the tegmina and costal area of the wings are rather prettily variegated with brown and ashy-ochreous. The head is rough and tuberculated, and has a number of short spines, besides two longer ones on each side of the crown a little behind the eyes. The mesothorax is not much longer (although very much broader) than the prothorax, and the upper surface of both is very uneven, minutely tuberculated and spined; there are two spines near the disk of each, besides others near the angles, and the sides of the mesothorax, as well as those of the metathorax, have each a number of various-sized spines; the breast is plane and smooth. The tegmina are elongate-oblong, with their apices broadly rounded; the middle of their surface, near the base of each, is conically elevated, and the elevation is surmounted by a number of acute tubercles; they are ashy-ochreous in colour, with numerous brown spots, besides an irregular oblique brown belt from the base to the middle of the hind margin; the apex also has a large brown spot, bordered on its inner side with black The costal area of the wings is coriaceous only towards the tip, where the organs project beyond the tegmina in repose, and the opake part is coloured like the tegmina, being ochreous, and having the tip brown with a short blackish belt a little before the tip; the membranous portion of the wings is smoky-brown. The abdomen is broad from the base to the end of the third segment; it then tapers gradually to the tip; the surface of the four basal dorsal segments is smooth, and their sides tuberculated; but the remaining segments are tuberculated throughout. The apical process is long, of uniform breadth, broad and entire at the tip, and shorter than the operculum, both together being strongly curved downwards. The legs are stout, the tibiæ unarmed, and the femora multidentate.

Hab. Menado, North Celebes (*Wallace*). One example in the collection of W. W. Saunders, Esq.

DIMORPHODES MANCUS, n. sp. Elongatus, angustus, scabrosus, cinereo-fuscus; capite oblongo, vertice postice spinoso; pronoto et mesonoto dorso antice spinosis; pedibus validis, sulcatis, femoribus omnibus parce denticulatis; antennis brevibus, filiformibus, articulo basali magno dilatato subovato; stylis analibus brevibus, foliaceis, ovatis.

Mas. Minor, angustior; capitis spinis obtusis; thorace verrucoso, pronoto et mesonoto antice spinis duabus, lateribus inermibus; tegminibus et alis brevissimis squamiformibus; abdomine apicem versus paulo dilatato et longitudinaliter rugoso. Segmentis omnibus subæqualibus; pedibus concoloribus, femoribus parce denticulatis; segmento ventrali ultimo medio conico-inflato.—Long. corp. 2″ 4‴; anten. 5‴; mesothor. 6‴; metath. 4‴. (Pl. XLIV. f. 3.)

Fœm. Major, robustior; capitis spinis acutis; thorace dorso tuberculato, pronoto antice acute quadrispinoso, mesonoto et metanoto antice bispinosis, lateribus multispinosis; apterus; abdominis lateribus denticulatis, segmentis dorsalibus tribus basalibus antice bispinosis; pedibus validis, femoribus quatuor posticis medio cinereo-fasciatis et supra denticulatis.—Long. corp. 3″ 9‴; anten. 8½‴; mesothor. 9½‴; metath. 6½‴. (Pl. XLIV. f. 8.)

Closely allied to *Dimorphodes Prostasis* (Westw.), notwithstanding the rudimentary condition of the wings and different form of the body of the male. The females of the two species have very great resemblance, almost the only points of difference being the number and form of their spines.

Body in both sexes elongate, parallel-sided, of a dingy-brown colour. Head oblong, and spined or tuberculated behind. Antennæ short, filiform, basal joint large, oval, and dilated. Legs stout, four posterior femora denticulated on their upper surface; anal styles short and compressed or foliaceous. In the male the body is covered with small tubercles, the pro- and metanota having each near their anterior edge a pair of larger and more acute tubercles. The legs are concolorous with the body, and the basal joint of the four hind tarsi is as long as the two following taken together. The abdominal segments are of nearly equal length throughout, and are longitudinally wrinkled towards the apex; the last dorsal segment is quadrate, with the angles rounded and terminal edge sinuated in the middle; the terminal ventral or genital segment is inflated in a conical form, and reaches the end of the penultimate dorsal.

In the female the sides of meso- and metanota and the corresponding sterna have a number of stout spines; their surfaces are also spined, as also those of the three basal dorsal segments of the abdomen, the front edge of each having a pair of larger spines; the pronotum has two pairs of similar spines near its front margin. The sides of the abdomen are minutely denticulated; the penultimate dorsal segment is raised and bicristate behind; the terminal segment is narrowed to the tip, with acute apical angles and broadly-notched apical margin. The operculum is scaphiform, and reaches the apex of the abdomen. The basal joint of the tarsi is much shorter than it is in the male, and the four posterior femora have an ashy belt in the middle.

Hab. Islands of Batchian and Ternate, Malay archipelago (*Wallace*).

There are five examples in Mr. W. W. Saunders's collection, one of them a female pupa, which does not differ in form and armature of the body from the adult, but wants the ashy belt of the four hind femora. One pair are ticketed as having been taken *in copulâ*.

PLATYCRANIA ALPHEUS, Westwood, Cat. Phasmidæ, Brit. Mus. p. 112, pl. iv. fig. 2 ♀.

The examples described by Professor Westwood came from Ceylon and the Philippines. In Mr. Saunders's collection there are three specimens of the female, obtained by Mr. Wallace in various islands of the eastern part of the Malay archipelago, namely Goram, Gilolo, and New Guinea. They all agree pretty well with the description and figure quoted above, but appear to resemble more the Philippine examples than those from Ceylon, in the stronger tuberculation of the mesonotum. All three differ greatly in the length of the tegmina and wings—organs which vary much in dimensions in many of the larger species of Phasmidæ. The examples which served Professor Westwood for his description appear to have had unusually short organs of flight; for he gives the length of the tegmina as one third shorter than the metanotum, and states that the wings, when closed, extend only to the middle of the second abdominal segment. These relative lengths are shorter than in any of the three examples from the Malay archipelago. Thus in the shortest-winged example (that from Gilolo) the tegmina reach the end of the metanotum, and the wings the middle of the third abdominal segment; in the Goram example the organs are a little longer; and in the New Guinea one the tegmina attain the middle of the first abdominal segment, and the wings the end of the fourth. The New Guinea specimen differs also in colour from the two others, being brown instead of green, and having brown tegmina and costal area of wings, with yellow nervures; but in this character it seems to be intermediate between the green examples and those described by Professor Westwood.

There is a male specimen from Amboyna, also in Mr. Saunders's collection, which appears to belong to this species; for although much resembling the male of *Platycrania edulis*, it differs in being much smaller and in wanting the rosy tint at the base of the wings. The following is a short description of it:—

Male. Elongate, slender, greenish-yellow (doubtless light green in life). Head oblong, convex, smooth; antennæ (about 26-jointed) filiform, twice the length of those of the female. Mesonotum covered with conical tubercles. Abdomen smooth, three terminal segments of equal length, apical dorsal segment narrowed behind; anal styles filiform, obtuse. Tegmina oblong-oval, and, with the costal area of wings, greenish-yellow, membranous portion of latter ochreous, longitudinal nervures darker. Legs moderately stout, four posterior thighs with three rows of small tubercles along their under surface.—Long. corp. 3″ 1‴; anten. 1″ 6‴; mesothor. 6‴; abdom. 1″ 10‴. Amboyna (*Wallace*).

ACROPHYLLA TESSELLATA, Westwood, Catal. Phasmidæ Brit. Mus. p. 115, pl. xxxv. fig. 1 (♂), fig. 2 (♀).

Three examples (two females and one male) of this elegant species in Mr. Saunders's collection agree remarkably well with the description and figures of Professor Westwood (made from a single pair), with the exception of the part which refers to the anal processes of the male. These are described as of "minute size," and in the figures appear not to project beyond the apex of the abdomen. It is possible that in Professor Westwood's example the organs may have been mutilated; for in the male specimen before me they are very conspicuous, extending to the length of a line or more beyond the tip of the abdomen. In form they are compressed or foliaceous, and do not differ from the corresponding appendages of the female except in their smaller size.

The terminal abdominal segment of the male is more deeply notched or cleft in the middle than is represented in the fig. 1 above cited; the inner edges of the cleft part on each side are denticulated as given in the fig. 1 *b*.

Hab. All the examples at present known are from Moreton Bay, Australia.

PODACANTHUS VIRIDI-ROSEUS, G. R. Gray, Syn. Phasm. p. 43; Westw. Cat. Phasmidæ Brit. Mus. p. 117 (female). *Mas.* Elongatus, gracilis, filiformis; capite subquadrato, vix convexo, oculis magnis; antennis hirsutis, elongatis, filiformibus (circa 23-articulatis); testaceo-flavus, thorace abdomineque obscure flavis; mesothorace supra spinis octo per paria seriatis, infra tuberculato, metathorace infra rugoso; abdomine lineari, segmento terminali angulis apicalibus valde productis forcipatis intus dentatis, segmentis genitalibus tumidis abbreviatis, stylis analibus maxime elongatis foliaceis compressis; pedibus validis, obscure flavis, femoribus quatuor posticis infra denticulatis, tibiis posticis intus spinosis; tegminibus areaque costali alarum viridibus, antice brunneis; alis membranaceis, roseis, nervis saturatioribus.—Long. corp. 4″ 5‴; anten. 1″ 11‴; mesothor. 3‴; stylis analibus $5\frac{1}{2}$‴; expans. alarum 4″ 4‴; long. tegmin. 8‴.

Male. The body is long and slender, the abdomen not being much thicker than the pro- and mesothorax. Its colour in life is probably light green. The apical dorsal segment has its terminal angles greatly prolonged and incurved, so that the two together form a forceps the inner sides of which are denticulated; the apical margin of the segment is also deeply cleft. The genital segments are tumid, especially the terminal one, which is also keeled, and does not pass, in length, the middle of the eighth dorsal segment. The middle and hind thighs have, beneath, two rows of strong spines; the hind tibiæ are pubescent on the inner side, and have two rows of fine denticulations; the basal joint of the tarsi, as in the female, is not much longer than the second. The tegmina are elliptical in form, and, like the costal area of the wings, green in colour, with a broad brown stripe along the anterior margin; the membranous portion of the wings is of the same rich rosy hue as in the female, the nervures being of a deeper tinge.

Hab. Moreton Bay, Australia. Sent by Mr. Diggles (Coll. of W. W. Saunders, Esq.).

In the same box which contained this insect there was a female example of the same species (now in Mr. Saunders's collection) far surpassing in dimensions the typical specimens that served Professor Westwood for his description. It measures in length of body $4\frac{1}{6}$ inches, and in expanse of wings $6\frac{3}{4}$ inches, whilst the measurements given by Professor Westwood are $3\frac{5}{6}$ inches and $5\frac{5}{6}$ inches respectively.

PHASMA CASTANEUM. *Fœm.* Cylindricum, robustum, obscure fuscum, capite antennis pedibusque nigricantibus; tegminibus subovatis, obtusis (carina valde flexuosa, medio obtuse elevata), obscure fulvis, macula virgulæformi nigricante; alis obtusis, area costali castanea, membrana fusca subdiaphana.—Long. corp. 2″ 7‴; anten. 2″

(circa); prothor. 2″; mesoth. 3‴; abdom. 1″ 1½‴+3½‴=1″ 5‴; tegmin. 4‴; alæ 1″ 11‴.

Closely allied to *Ph. putidum*, but more robust in body, and having rather more rounded wings. The great difference, however, is in the form of the tegmina, which are rounded or ovate in outline, and have very strongly flexuous central carinæ, the elevated part of which is not acute, but blunt or broadly rounded; the black spot on the costal side of the elevation is not in the form of a stripe, but a broad comma-shaped spot, occupying the space between the central carina and the subcostal one. The colour of the tegmina is tawny-ochraceous, and the costal area of the wings differs from that of *Ph putidum* and allied species in being of a uniform tawny-chestnut hue. The membrane is of a very dark brown, and scarcely transparent. The antennæ and legs are wholly blackish. The upper side of head and anterior parts of the thorax are rough on the surface and dingy tawny-brown in colour, and there is a yellowish line along each side of the head behind the eyes. The terminal dorsal segments of the abdomen are slightly raised in the middle of their hind margins. The anal styles are very short and linear. The operculum reaches nearly to the dorsal tip of the abdomen, and is narrowed to a point at the apex.

Hab. Pará, Amazons. One example (♀).

PHASMA PUTIDUM. *Mas et Fœm.* Cylindricum, fuscum, capite pro- et mesothorace et tegminibus pallide griseo-brunneis, his vitta lata nigro-velutina; pedibus rufescentibus, femoribus (basi excepta) nigris; capite subquadrato, supra plano; mesothorace brevi, lineari, acute granulato; tegminibus carina medio valde elevata conica compressa, deinde ad marginem recta; alarum area costali olivacea, venis maculisque obscurioribus, membrana pallide olivaceo-fusca diaphana; stylis analibus brevibus, obtusis; antennis setaceis, elongatis. (Pl. XLV. f. 2.)

Maris segmento dorsali terminali obtuso, segmentis genitalibus valde tumidis, conicis, apice emarginato.

Fœminæ operculo lato, parum convexo, acuminato.

♂ Long. corp. 2″ 3‴; anten. 2″ 6‴; mesothor. 2¾‴; abdom. 1″ 2‴+3‴=1″ 5‴; tegmin. 2¾‴; alæ 1″ 5‴.

♀ Long. corp. 2″ 10‴; mesothor. 3‴; abdom. 1″ 4‴+3½‴=1″ 7½‴; tegmin. 4½‴; alæ 2″.

Closely allied to *Phasma Menius*, Westw. (Cat. Phasm. pl. xvii. f. 2), but differs in the remarkable compressed-conical and acute elevations of the central part of the median carina and in the uniform dingy-brown colour of the wing-membranes. The body is of a dingy-brown hue; but the upper surface of the head, pro-, and mesothorax is of a pale greyish colour; the tegmina are also of this colour, but they have each a broad black vitta extending from the base to the apex, and covering the costal side of the triangular elevation of the median carina. The costal area of the wings is of a dull olive-green hue, speckled irregularly with darker olive. The legs are pale tawny reddish, with the femora (except near the base) nearly black. The antennæ are blackish, with the bases of the joints pale reddish. The abdomen in the female has the posterior edge of the two or three penultimate segments elevated in the middle. The three basal joints of the posterior tarsi are produced at their apex (on one side) into a lobe.

Hab. Santarem, on the Amazons. Taken by myself.

The following is an extract from my notebook referring to this insect:—"The commonest species in these woods, and, I think, generally distributed. It moves slowly over the branches and leaves of low trees, and flies readily, but heavily, when disturbed. When seized with the hand, a dark liquor oozes from the mouth and other parts of the body, emitting a most peculiar and disagreeable odour. In copulation the male mounts on the back of the female, his head reaching only as far as the elytra of his partner, and grasps her body strongly with his anterior legs, the flexible apex of the abdomen being curled round to the genital organs of the female underneath the tip of her abdomen."

Hab. There is a male specimen also in Mr. Saunders's Collection, labelled as from Peru.

PHASMA QUADRATUM. *Mas.* Cylindricum, tenue, viride, olivaceo-fusco variegatum; capite subquadrato, supra plano, ocellis patentibus; tegminibus oblongo-quadratis, apice recte subtruncatis, carina ante medium in spinam validam acutam exeunte; alarum area costali olivaceo-viridi plagiata, membrana pallide fusca diaphana; abdomine elongato; stylis analibus brevibus, cylindricis; segmento ventrali 8vo profunde emarginato; pedibus brevibus.—Long. corp. 1″ 10‴; anten. 1″ 10‴; mesothor. 2‴; abdom. 11‴+3‴=1″ 2‴; tegmin. 3‴; alæ 1″.

Allied to *Phasma maculatum* (Gray and Westw.), but distinguished by the elongate, oblong, and obtusely but straightly truncated tegmina. The raised part of the carina, in consequence of the prolongation of the apical part of the tegmina, is much nearer the base than the apex, and is, moreover, surmounted by a rather long and sharp spine, inclined towards the apex of the tegmen. The colour of the tegmina, like that of the body, antennæ, legs, and costal area of the wings, is obscure-olivaceous, relieved by indistinct marks of a clearer green. The membrane of the wings is light brown, without trace of deeper shade towards the margins. The legs are extremely short (as in many allied species of Phasma, especially from the same country), the hind legs, when extended, being much shorter than the abdomen (10½ lines).

Hab. Forests of the Tapajos, near Santarem. One example (♀).

NECROSCIA LONGICEPS. *Mas.* Cylindrica, tenuis, glabra, lutea, capite thoraceque linea laterali nigra; capite thorace multo latiore, oblongo-elongato, postice haud attenuato, oculis prominentibus; antennis brevibus, filiformibus, basi haud dilatatis; abdomine lineari, segmento dorsali terminali apice utrinque producto lobato, segmentis genitalibus haud tumidis; stylis analibus paulo elongatis, clavatis; tegminibus angustis, medio vix elevatis, apice obtuse truncatis, cum alarum area costali brunneis, medio vitta straminea; alarum area postica carneo-fulva, opaca; pedibus tenuibus, femoribus infra breviter spinosis.—Long. corp. 2″; anten. 8‴; capit. 2¼‴; mesothor. 4½‴; abdom. 11‴+2‴=1″ 1‴; ped. ant. 1″ 10½‴; ped. intermed. 1″; post. 1″ 3‴; tegmin. 2½‴; alæ 1″. (Pl. XLV. f. 6.)

From Serville's description of his mutilated specimen of *N. vittata* (Orthopt. p. 254), the present seems closely allied to that species; it differs, however, in the opake roseate-tawny hue of the posterior area of the wings. The species belongs to the section of the genus indicated (in the description of our *N. cephalotes*) as distinguished by the great size of the head and short filiform shape of the antennæ. The body is slender and filiform, the head being the broadest part; the colour is pale luteous, but probably green in life, some traces of this colour being seen on the head; and there is a black line extending on each side from the eye to the base of the mesothorax. The antennæ are only one-third the length of the body, and filiform, the base not being much thicker than the remaining part; there are two elevated lines along each side of the mesonotum, and the surface is faintly warty. The apical dorsal segment of the abdomen has its terminal angles each produced into a short curved lobe; and the anal styles project a short distance beyond them, and are clavate in shape. The tegmina are narrow, and obtusely truncated at the apex; their central elevation is but slightly prominent, and their colour, together with that of the anterior field of the wings, is brown, with a straw-coloured vitta extending along the middle from base to apex; the posterior field is of a uniform tawny-pink hue and opake. The legs are rather short (except the anterior pair); and the intermediate and posterior femora have a row of minute spines along their under surface, the anterior pair having only a few similar spines near their tips.

Kaioa Island, near Batchian (*Wallace*). One example (♂) in the collection of W. W. Saunders, Esq.

NECROSCIA CEPHALOTES. *Fœm.* Cylindrica, robusta, glabra, capite magno, crasso, fulvo, vittis quinque nigris; antennis brevibus, filiformibus, articulo basali haud dilatato; thorace et abdomine luteis, vitta laterali communi nigra; abdominis segmento dorsali 8vo præcedentibus multo longiore; operculo lineari, apicem dorsalem haud attingente; tegminibus angustis, elongatis, apice truncatis, cum area costali alarum brunneis, vitta longitudinali straminea; alis brevibus, area postica sordide lactea; pedibus elevato-lineatis, nigris, fulvo maculatis, femoribus apice infra denticulatis.—Long. corp. 3″ 6‴; capit. 4‴; anten. 8‴; mesothor. 9‴; metath. 3½‴; abdom. 1″ 3½‴ +6½‴=1″ 10‴; ped. antic. 3″, ped. post. 2″ 3‴; tegmin. 3½‴; alar. 9½‴.

Resembles much *N. Palinurus*, Westw. (Cat. Phasm. pl. xi. f. 6), but differs in coloration. Cylindrical, robust, tawny-coloured, smooth. Head very large and of equal thickness, oblong, slightly narrowed behind the eyes, unarmed, reddish-tawny, with five black stripes—namely, one central, not reaching the level of the eyes, one on each side from the eye to the occiput, and another quite lateral, abbreviated. Antennæ short, filiform, basal joint not enlarged. Thorax and abdomen dingy-tawny, with a black stripe on each side, extending from the prothorax to the last abdominal segment. Abdomen cylindrical; the eighth dorsal segment the largest of all, and much longer than the seventh; apical segment one-third the length of the eighth, and narrowed to the tip, in the middle of which there is a small but distinct notch. Operculum linear, not convex, and not reaching the apex of abdomen; anal styles exserted, brown, compressed. Tegmina narrow and elongate, central prominence slightly marked, brown, with a central straw-coloured vitta; costal field of the wings of the same colour; posterior field dingy-white, opake. Legs moderately stout, ridged, and furrowed; anterior legs much elongated, the tarsi especially extremely long (7½ lines); all the femora with a single row of denticulations at the apex beneath; colour black, speckled with yellowish.

Hab. Taken by Mr. Wallace in New Guinea. Collection of W. W. Saunders, Esq.

This species, together with *N. capito, N. Palinurus, N. longiceps* and probably *N. Styxius*, Westw. (Cat. pl. ix. f. 3), and *N. vittata,* Serv., are sufficiently distinct from the other species of Necroscia, in their short antennæ and enlarged head, to form a separate genus.

NECROSCIA PICTIPES. *Fœm.* Cylindrica, thorace antice angustiore, pallide viridis, capite supra lineis duabus nigris; tegminibus intus purpureo marginatis, colore purpureo ramum medianum emittente; alarum area costali, postice sanguineo vittata, membrana lactea roseo vix tincta; pedibus flavidis, femoribus anticis maculis duabus, femoribus intermediis annulo unico tibiisque macula subapicali nigris.—Long. corp. 3″; mesothor. 5¼‴; abdom. 1″ 5‴+3‴=1″ 8‴; tegmin. 3‴; alæ 1″ 10‴.

Allied to *N. annulipes* (Gray), Westwood (Cat. Phasm. p. 150); but greatly differing in the colour of the wing-membrane, which is of deep rosy hue in *N. annulipes* and whitish-opake in *N. pictipes* with scarcely a trace of other colour. In other respects the differences are only such as might exist in the opposite sexes of one and the same species, our example of *N. pictipes* being a female, and the specimen described by Mr. Westwood a male. *N. pictipes* is very much stouter (although not longer); and the head is oblong-quadrate, scarcely attenuated behind; the two black lines along the crown do not extend to the thorax, as they do in *N. annulipes*, besides being different in other respects. The pro- and mesothorax are light-green, with a broad reddish-brown stripe down the middle. The tegmina are oblong-quadrate, and their carina is rather strongly elevated in the middle; their colour is pale green, with the inner margin broadly purple, which colour emits a branch in the middle towards the central elevation. The costal area of the wings is also light green, with a reddish-purple vitta running very near the hind margin from base to apex. The legs are moderately short, unarmed, and yellowish; the anterior femora have two blackish spots on their inner side, the middle femora a blackish ring, and the middle tibiæ a brown spot towards their apex; the hind legs are spotless. The abdomen, in its faded state, shows traces of a pale hue on the apical part, with a broad purple stripe down the middle, as in *N. annulipes*; the terminal dorsal segment has its apical angles produced and acute; the genital operculum is unusually short, and is truncated at the apex.

Hab. Chantaboun, Cambodia (*Mouhot*). One example (♀).

NECROSCIA VIRIDILINEATA. *Mas et fœm.* Linearis, olivacea, subtus pallide viridis, tegminibus et alarum area costali viridi-lineatis; pedibus viridibus, tibiis apice nigris; capite curto, suborbiculari, absque ocellis, oculis valde prominentibus; thorace cylindrico; membrana alarum pallide fusca, hyalina.—♂ long. corp. 1″ 10‴; anten. 2″ 3‴; mesothor. 3½‴; abdom. 9½‴+2½‴=1″; tegmin. 2‴; alæ 1″ 4‴. ♀ long.

corp. 2″ 10‴; anten. 2″ 6‴; mesothor. 4½‴; abdom. 1″ 3‴+4½‴=1″ 7½‴; tegmin. 3‴; alæ 2″.

This is a slender and linear species with remarkably short head, convex and broadly rounded behind the eyes. The head, pro- and mesothorax, tegmina, and costal area of the wings are dark olive-brown, with slender green lines along the principal nervures of the alary parts, the legs (with the exception of the dark apices of the tibiæ) and the under surface of the body being light green. The antennæ are very long and slender, dark-brown, with the bases of the joints pallid. The eyes are very salient. The tegmina are oblong, quadrate, broad at the apex, with the outer apical angle produced, and the central carina conical in the middle. The membrane of the wings is light brown and transparent. In the male, the tip of the abdomen is blackish, the three dorsal apical segments not much abbreviated, and the anal styles short and obtuse; the genital segments are not tumid. In the female, the seventh dorsal segment is not shorter than the sixth, and considerably longer than the eighth or ninth; the last-mentioned is narrowed to the apex, and the genital operculum is broad and scarcely reaches the tip of the abdomen.

Hab. Ceram (*Wallace*). One pair in Mr. Saunders's Collection.

NECROSCIA FRONDOSA. *Fœm.* Valde elongata, cylindrica, pallide flavescenti-viridis; alarum membrana albo-virescente, diaphana, vix roseo tincta; thorace granulato; segmentis dorsalibus tribus terminalibus multo abbreviatis; stylis analibus ultra apicem exsertis, linearibus; operculo angusto, apice inciso; tegminibus oblongis, apice oblique truncatis; carina mediana modice conico-elevata, nigricante.—Long. corp. 3″ 9‴; anten. 3″; mesothor. 6½‴; abdom. 1″ 10‴+4‴=2″ 2‴; tegmin. 3¼‴; alæ″ 2 2‴.

Closely allied to *N. Aruana*, Westw. (Cat. Phasm. plate xxxix. fig. 4), but different in colour, being wholly of a pale greenish yellow (probably pale green in life), and the membrane of the wings greenish or yellowish-white, with a very faint rosy tinge. The head is oblong, as in *N. Aruana*, and the thorax (except upper surface of metathorax) uniformly granulated over its whole surface. The tegmina and costal area of the wings are pale greenish in colour, and there is no pale streak extending from the slightly elevated conical carina, which is so characteristic of *N. Aruana*. The legs are uniform yellowish green.

Hab. Menado, Celebes (*Wallace*). One example, female.

NECROSCIA LACTEIPENNIS. *Mas et Fœm.* Filiformis, gracilis, omnino pallide griseo-brunnea, olivaceo marmorata vel maculata, alarum membrana hyalino-sublactea excepta; capite oblongo-quadrato, postice paulo attenuato, supra plano, inermi, absque ocellis, oculis prominulis; antennis tenuibus, longitudine corporis; mesothorace lineari; abdomine maris apice emarginato; stylis analibus brevibus, linearibus; tegminibus breviter oblongis, supra medio haud prominulis; pedibus brevibus, tenuibus.—♂ long. corp. 2″ 6‴; mesothor. 5½‴; abdomin. 1″ 3‴+3″=1‴ 6;

tegmin. 1½‴; alæ 1″ 3½‴. ♀ Long. corp. 3″ 6‴; mesothor. 8‴; abdom. 1″ 8‴+5‴=2″ 1‴; tegmin. 2‴; alæ 1 10‴.

A slender and delicate-looking species, of a uniform pallid greyish brown colour, faintly marbled with olive-brown; the membrane of the wings transparent and tinged with a milky hue. The body and legs are unarmed; the apical dorsal segment in the male is triangularly emarginated at the apex, and the edge of the emargination has a row of small tubercles. The operculum of the female is simple, and reaches barely to the tip of the abdomen; the anal styles are short and linear, but slightly tapering to the apex.

Hab. Island of Gilolo (*A. R. Wallace*). One pair in the Collection of W. W. Saunders, Esq.

Necroscia acutipennis. *Fœm.* Cylindrica, elongata, inermis, viridis; alis pallide flavis, apice productis, acutis; tegminibus elongatis. Long. corp. 2″ 2‴; anten. 2″ 3‴; mesothor. 7‴; metath. 4½‴. (Pl. XLV. f. 5.)

Elongate, cylindrical, and moderately slender; the body, antennæ, legs, tegmina, and anterior area of the wings pale grass-green; posterior area of the wings very pale greenish yellow, uniform. The head is oblong, plane above, and not at all narrowed behind the eyes, the latter moderately prominent. The mesothorax is much elongated, cylindrical and smooth. The legs are unarmed. The operculum is boat-shaped, and reaches the dorsal tip of the abdomen; the anal styles are small and obtuse. The tegmina are elongated and tapering to the tip, and the central prominence forms a moderately elevated flexuous ridge; an obscure pale line runs down the middle of each tegmen. The wings are produced and acute at the apex.

Hab. Ceylon (*Nietner*). Collection of W. W. Saunders, Esq.

Necroscia Janus. *Fœm.* Major, cylindrica; capite prothorace et mesothorace supra ochraceo-albidis, opacis, infra obscuro-fuscis; tegminibus fuscis, intus cretaceo marginatis; alarum area costali flava, costa late fusca, area postica hyalina, parum fuliginosa; capite oblongo-quadrato, supra plano, oculis valde prominentibus; antennis longitudine corporis, fuscis; pronoto postice unituberculato; abdomine pallide-olivaceo, segmento ultimo dorsali apice obtuso; stylis analibus brevibus, filiformibus, obtusis; operculo lineari, apicem dorsalem attingente; pedibus subgracilibus, elevato-lineatis inermibus.—Long. corp. 3″ 6‴; mesothor. 7½‴; abdom. 1″ 7½‴+4½‴=2″; tegmin. 3‴; alæ 2″. (Pl. XLV. f. 4.)

A large and rather robust species, with moderately elongated but linear mesothorax, and oblong quadrate, plane-crowned head. The upper side of the head, prothorax, and mesothorax is opake, pallid ochraceous; but the under surface, in striking contrast, is of a blackish-brown hue; the broadish, obliquely and obtusely truncated tegmina and the anterior area of the wings offer a similar contrast of colours, the tegmina being dark-brown, with the inner margin irregularly bordered with chalky-ochraceous, and the costal area of the wings being light yellowish, with a broad dark-brown costal stripe not extending to the tip. The eyes are large and prominent, the pronotum has a small tubercle in the middle of its posterior portion, the rest of the body and legs are unarmed. The antennæ are setaceous, slender, and of about the same length as the body.

Hab. Tondano, Celebes (*Wallace*). One example (♀), Coll. W. W. Saunders, Esq.

Necroscia styligera. *Fœm.* Major, cylindrica, griseo-brunnea, pallida, fusco vix nebulosa; alarum area postica hyalina, paulo fuliginosa; mesothorace lineari, supra lineis vel rugis longitudinalibus instructo; capite quadrato, supra plano, oculis prominentibus; antennis setaceis, elongatis; pedibus subgracilibus, inermibus; abdominis segmento dorsali ultimo angustato, apice inciso; operculo in stylum acutissimum longe ultra apicem dorsalem prolongato.—Long. corp. 3″ 8‴; anten. 2″ 10‴; mesothor. 8‴; abdom. 1″ 9‴+4½‴=2″ 1½‴; operculi 9‴; tegmin. 3‴; alæ 2″. (Pl. XLV. f. 1.)

The species in the female sex (the only one known) is distinguished by the peculiar form of the genital operculum, which is ¾ of an inch in length and very narrow and horny, tapering into a very sharp, needle-like point; the segment which constitutes the operculum, instead of forming a semitubular or boat-shaped duct, appears like a solid compressed spine, owing to the coalescence above of its up-turned edges. The insect otherwise has nothing remarkable, being very similar in shape and proportions of body and limbs to *N.? Janus*; its colour is throughout of a pallid greyish brown, faintly marbled with darker brown, except the membrane of the wings, which is semitransparent and slightly smoky. The mesothorax is longitudinally wrinkled, the antennæ are very slender, the tegmina are short and broad, with the central elevation not very prominent.

Hab. Sula Islands (*A. R. Wallace*). One example (♀), Coll. W. W. Saunders, Esq.

Necroscia mustea. *Mas.* Cylindrica, gracilis, pallide brunnea; tegminibus et alarum area costali viridibus, membrana hyalina, fusco perparum tincta; capite suborbiculari; mesothorace granulato; abdomine apice clavato; stylis analibus paulo elongatis, curvatis, apice subincrassatis; tegminibus carina mediana conico-elevata, basi macula elongata, albida; pedibus elongatis; femoribus tibiisque partim viridibus; antennis longissimis.—Long. corp. 2″ 1‴; anten. 2″ 6‴; mesothor. 5½‴; abdom. 11‴+3‴=1″ 2‴; tegmin. 1¾‴; alæ 1″ 1½‴. (Pl. XLV. f. 8.)

The head is short, and rounded behind the eyes, and not plane above, with very prominent eyes and no ocelli. The antennæ are slender and greatly elongated, their colour a uniform brown. The prothorax is narrowed posteriorly; the mesothorax is slender and linear, and its surface has a number of distinct granulations; the colour of head, thorax, and abdomen, in the faded insect, is brown; the legs are partly brown and partly green; so that the insect is possibly green in the living state. The three terminal dorsal segments are dilated, and the genital segments are strongly tumid, and reach nearly to the tip of the abdomen; the anal styles project much beyond the apex of the abdomen, and are slightly curved upwards and thickened at their tips. The tegmina are oblong and obliquely truncated, their carina rises into a moderate but acute elevation in the middle, and between the elevation and the base there is a whitish streak, the rest of the surface, like the costal area of the wings, being of a clear light green hue. The membrane of the wings is transparent, and very slightly tinged with pale greenish brown.

Hab. Sula islands (*Wallace*). One example, Coll. W. W. Saunders, Esq.

Necroscia Agrionina. *Mas.* Linearis, tenuissima, pallide brunnea; alarum membrana hyalina fusco perparum tincta; capite subquadrato, supra plano; oculis valde prominentibus; antennis setaceis, pallidis; mesothorace lineari; abdominis segmento ultimo dorsali bisinuato, apice emarginato; stylis analibus brevibus, linearibus; segmentis genitalibus nullomodo tumidis, apicali acuminato; tegminibus brevissimis, subquadratis, apice valde obliquis; pedibus brevibus, tenuibus.—Long. corp. $1'' 6'''$; anten. $1'' 4'''$; mesothor. $3\frac{1}{4}'''$; abdom. $9'''+1\frac{3}{4}'''=10\frac{3}{4}'''$; tegmin. $\frac{1}{2}'''$; alæ $9'''$. (Pl. XLV. f. 9.)

Allied to *Necroscia Osmylus*, Westw. (Cat. Phasm. plate xxxvii. fig. 4), but slenderer, and the terminal dorsal segment of the abdomen of quite a different form. The insect has much the aspect of a slender Dragonfly of the genus *Agrion*. The body, legs, tegmina, and costal area of the wings are a pale brown colour, varied with lighter and darker shades, and apparently not green in life; the upper side of the two basal dorsal segments of the abdomen is darker than the rest in the faded specimen; the membrane of the wings is transparent, and very slightly tinged with brown. The antennæ are very pale-brown, with a number of very small rings of a shade darker hue. The three terminal abdominal segments are of equal length, and much shorter than the preceding segments; the apical segment is bisinuate on each side, and broadly emarginated at the apex, at which point it is scarcely narrower than at the base. The genital segments are short and not at all tumid, the apical segment being narrowed to a point. The tegmina, although tolerably broad, are extremely short, and the central carina is not prominent in the middle.

Hab. Menado, Celebes (*Wallace*). One example (♂), Coll. W. W. Saunders, Esq.

Necroscia graminea. *Fœm.* Cylindrica, pallide viridis, tegminum et alarum marginibus costalibus pallidioribus; capite curto, suborbiculari; mesothorace brevi, cylindrico, supra ruguloso; membrana alarum diaphana, leviter fuscescente. Long. corp. $2'' 4'''$; anten. $2'' 4'''$; mesothor. $3'''$; abdom. $1'' 1''' + 3\frac{1}{2}''' = 4'' 4\frac{1}{2}'''$; tegmin. $3'''$; alæ $1'' 9'''$.

Closely resembling *N. viridilineata* in form of head and tegmina; differs in its shorter and broader (although still cylindrical) mesothorax and in its colours. The head is short, and broadly rounded behind the eyes, which latter are very prominent, and there are no ocelli. The antennæ are very slender and elongated; their colour is brown with bases of joints pallid. The upper surface of the mesothorax is coarsely roughened. The tegmina are oblong and very obliquely truncated, with the outer angles rather prominent; they are, like the head, pro- and mesothorax, and costal area of the wings, of a light green colour; but the areoles between the nervures are dark olive, and the costa (as well as the costa of the wings) is margined with a paler or yellowish hue. The membrane of the wings is very pale tawny-brown and transparent. The abdomen, mesothorax, and legs are pallid-brown in their faded state, but probably green in life. The seventh dorsal segment is much shorter than the sixth, and about equal in length to the eighth and ninth; the latter is much narrowed towards the apex, and the apex itself is bluntly rounded. The anal styles are short, linear, and pointed. The genital operculum is flat and suddenly dilated about the middle, tapering thence to a point, so as to resemble altogether in figure a spear-head; its surface is pubescent, and it reaches nearly to the tip of the abdomen.

Hab. Batchian (*Wallace*). One example (♀) in Mr. Saunders's Collection.

NECROSCIA TENEBROSA. *Fœm.* Cylindrica (mesothorace antice et abdomine apice angustatis), inermis, obscure olivaceo-fusca, opaca; alarum area costali nigro multifasciata; pedibus pallide annulatis; alarum membrana pallide fusca, diaphana; capite breviter oblongo, absque ocellis, nigro-trilineato; oculis valde prominentibus; antennis setaceis, elongatis, obscuris; abdominis segmentis quatuor terminalibus subito angustatis; stylis analibus exsertis, porrectis, acutis; segmento ventrali sexto apice inciso; operculo lineari, tenui, apice integro; tegminibus apice late rotundatis, valde convexis, conicis; alis late rotundatis; pedibus elongatis.—Long. corp. 2″ 9‴; anten. 2″ 2‴; mesothor. 4½‴; abdom. 1″ 3½‴ + 3½‴ = 1″ 7‴; tegmin. 2¾‴; alæ 1″ 8‴.

In form this species closely resembles *N. Erechtheus*, Westw. (Cat. Phasm. pl. xiv. f. 6), but it differs widely in colour, the membrane of the wings being pale brown, without a trace of red, and the head, thorax, and coriaceous parts of the wings of a dark olive-brown, marbled and streaked with a darker and blackish tint; the costal area of the wings is crossed by several irregular, oblique, blackish-olive belts, which form about three indistinct broad fasciæ. The thorax is narrowed anteriorly, and is, like the head, free from granulations and spines. The four terminal segments of the abdomen are narrower and shorter than the rest; the anal styles project beyond the extremity, and are pointed. The sixth ventral segment is notched at the apex; and the operculum is short, narrow, and very little convex; its apex is entire and pointed. The legs are rather elongated, the anterior pair being nearly two inches in length; they are of a dusky olive-brown, spotted and ringed with a much paler hue of brown.

Hab. Ceylon (*Nietner*). Two examples (♀) in Mr. Saunders' Collection.

NECROSCIA SMARAGDULA. *Mas.* Filiformis, gracilis, capite, prothorace et mesothorace læte cæruleo-viridibus; metathorace infra læte rufo, eodem supra et abdomine pallide rufo-olivaceis; pedibus rufis; tegminibus et alarum area costali flavis, apicem versus fusco-variis, area postica hyalino-fuliginosa; stylis analibus brevibus, linearibus, valde obtusis; capite orbiculari, ocellis nullis, oculis magnis; mesothorace rugoso; antennis fuscis, articulis basi pallidis, prope apicem annulo lato flavo.—Long. corp. 1″ 8‴; mesothor. 3‴; metath. 3½‴; anten. 1″ 10‴. (Pl. XLV. f. 7.)

This elegant and gaily-coloured species is not closely allied to any other that I have been able to examine. The head is suborbicular, being short and regularly rounded behind the large and prominent eyes; it is unarmed, smooth, and without ocelli. The antennæ are longer than the body, light brown, pale at the bases of the joints, and have a broad yellowish ring before the apex; the basal joint is not greatly thicker than the rest. The prothorax is narrower and rather longer than the head, and smooth. The mesothorax is roughly granulated above and beneath; and the sides of the pronotum have each two distinct raised lines. The colour of head, pro-, and mesothorax is throughout a clear light bluish green. The metathorax above and the abdomen are of a dingy faded brownish hue, but the metathorax beneath is of a light red hue. The abdomen is cylindrical and shining, the terminal dorsal segment is truncated at its apex; the genital segments are smooth, and not very prominent; the anal styles short, cylindrical, and very obtuse at the apex. The legs are quite simple and of a uniform reddish colour. The tegmina are short and truncated at the apex, the prominence in the middle is conical and obtuse; they are of a yellowish colour, brown towards their tips, but sometimes uniform yellow; the wings are obtuse, smoky hyaline, paler towards the base, and their costal area is similarly coloured to the tegmina, *i. e.* yellowish, with brown tips and edges.

Hab. Islands of Gilolo and Batchian, taken by Mr. A. R. Wallace. (Coll. W. W. Saunders, Esq., three examples).

NECROSCIA CONICIPENNIS. *Fœm.* Cylindrica, sordide olivaceo-fusca, granulata; tegminibus et alarum area costali olivaceo-nebulosis, maculis obscurioribus et plagis pallidioribus signatis; capite quadrato, supra plano, declivi, absque ocellis, oculis valde prominentibus, supra fulvo, lateribus olivaceis; antennis setaceis, olivaceis, fulvo multiannulatis; mesothorace cylindrico, (cum prothorace) opaco, granuloso, medio bituberculato; abdominis segmentis dorsalibus tribus terminalibus paulo abbreviatis; stylis analibus filiformibus, curvatis; operculo haud convexo, apice inciso; tegminibus apice late rotundatis, medio valde conico-elevatis; membrana alarum pallide fusca, diaphana; pedibus brevibus, pallidis, olivaceo-nebulosis, femoribus tibiisque apice obscurioribus.—Long. corp. 2″ 8‴; anten. 1″ 10‴; mesothor. 4½‴; abdom. 1″ 2½‴+3½‴=1″ 6‴; tegmin. 3‴; alæ 1″ 11‴.

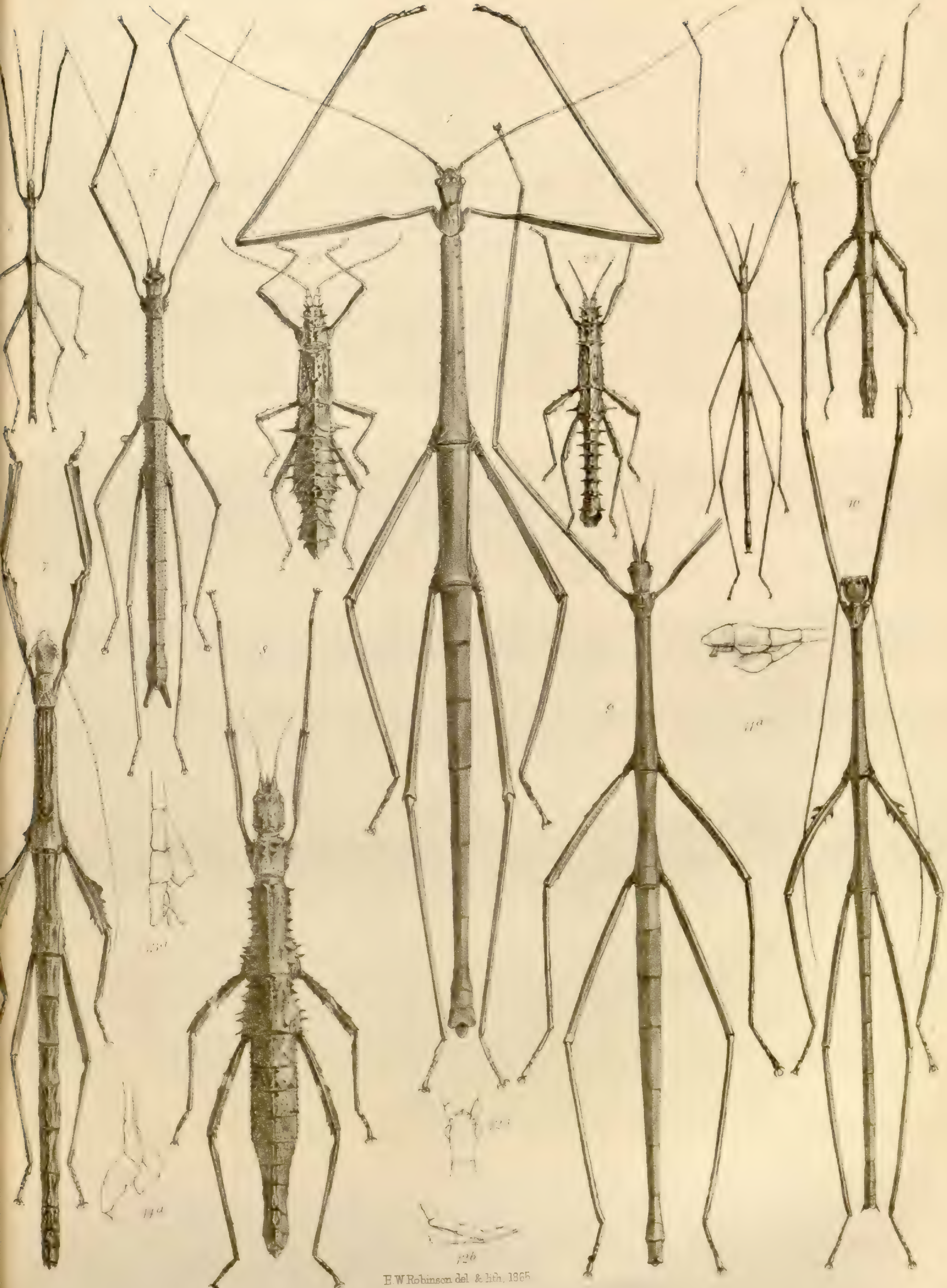
Resembles *N. Larunda*, Westw. (Cat. Phasm. pl. xxvii. f. 3), in general form and colours, but differs greatly in its shorter tegmina, with extraordinarily high and acute median elevation. The head is rather short and subquadrate in shape, the crown plane (leaving a prominent occiput) and fulvous, while the rest of the head is dull olivaceous. The eyes are very prominent. The antennæ are very slender, and alternately ringed with dark olive and fulvous. The pro- and mesothorax, and under side of metathorax, are rough and opake, but not acutely tuberculate, the mesothorax having only two faintly elevated and obtuse tubercles in the middle. The genital operculum reaches the dorsal tip of the abdomen, and is of the ordinary oblong shape, with the apex notched in themiddle, as in *N. Aruana* (Westw.), *N. Siphylus* (Westw.), *N. Larunda* (Westw.), and several other species. The legs are rather short, and variegated with light and dark brown and olive-brown, with the tips of the femora and tibiæ much darker.

Hab. Sumatra (*Wallace*). One example (Coll. W. W. Saunders, Esq.).

NECROSCIA TORQUATA. *Fœm.* Cylindrica, robusta, capite breviter ovato, convexo, inermi; mesothorace brevi, antice constricto, postice tumido; tegminibus latis, subquadratis, carina media conicana; capite, prothorace, metathorace, pedibus et corpore subtus nigris opacis; abdomine supra rufo; pronoto antice et postice metanotoque antice albo-marginatis; antennis nigris, griseo-annulatis; tegminibus et alarum area costali fusco-nigris, viridi læte maculatis; pedibus brevibus, inermibus.—Long. corp. 2″ 6‴; mesotho. 3¼‴; abdom. 1″ 2‴+3‴=1″ 5‴; tegmin. 3½‴; alæ 1″ 9‴. (Pl. XLV. f. 3.)

Resembling very closely, in form and in the proportions of the different parts of the body, *N. hilaris*, Westw. (Cabinet of Oriental Entomology, pl. 38. f. 1), but quite different in colour, and the mesothorax simply tumid behind instead of having two distinct tubercles. The head is short, ovate, convex, and destitute of ocelli; the antennæ are long and setaceous, dusky, ringed with grey. The head, pro- and mesothorax, legs, and body beneath are dull opake sooty black, but the anterior part of the thorax has two yellowish rings. The abdomen above is reddish, probably bright red in life. The tegmina and anterior area of wings are olive-black, with numerous and distinct spots of a beautiful light green colour; the membrane of the wings is transparent, uniformly tinged with a dusky hue. The legs are all rather short and unarmed. The anal styles are short and linear, and the operculum reaches the end of the abdomen.

Hab. Chantaboun, Cambodia (*Mouhot*). One example (♀), Coll. W. W. Saunders, Esq.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E. W. Robinson del. & lith. 1865

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XI.—*On* Hillebrandia, *a New Genus of* Begoniaceae.

By Professor Oliver, *F.R.S., F.L.S., Keeper of the Kew Herbarium.*

(Plate XLVI.)

Read November 2nd, 1865.

HILLEBRANDIA, genus novum Begoniacearum.

Char. Gen. Flores monoici. *Masculi*: Sepala 5. Petala 5, parva, cucullata, sepalis alterna. Stamina indefinita, filamentis liberis; antheris oblongis ellipticisve, muticis, rimâ marginali dehiscentibus. *Feminei*: Calyx tubo hemisphærico exalato, limbo perigyno 5-partito[*]. Petala 5, eis fl. ♂ similia, perigyna, lobis calycis alterna. Styli 5, distincti, persistentes, lobis calycis oppositi, bifurcati, lobis spiraliter stigmatosis. Ovarium apice liberum, hians, subuniloculare; placentis 5, parietalibus, bilamellatis, utrinque ovuliferis, plus minus basi irregulariter coalitis. Capsula membranacea, vertice exserto, foramine lato inter stylos aperta. Semina indefinita, oblongo-obovoidea, exalbuminosa, testa areolata; embryone cotyledonibus brevibus, radicula obtusa.—Herba Sandwicensis habitu omnino *Begoniæ*: differt floribus petaliferis, placentatione atque capsula apice hiante indehiscente.

H. Sandwicensis, species unica.

Herba succulenta, ramis sparse pilosulis vel glabratis. *Folia* petiolo longiora, oblique cordato-rotundata, sæpius plus minus irregulariter 5–7–9-loba, lobis triangularibus vel rotundatis, acutis vel obtusis, inæqualiter serratis, utrinque (subtus præcipue ad nervos) pilosulis, 4–8 unc. longa et lata. *Pedunculi* ½–1-ped., erecti, glabri v. sparsim pilosuli, apice in cymam bisexualem, dichotome paniculatam, multiflorem divisi. *Bracteæ* membranaceæ, oppositæ, ovato-rotundatæ vel cordatæ, apiculatæ, inferiores ⅓–½ unc. latæ. Flores ♂: *Sepala* 5, ovata, acutiuscula, exteriora paulo majora. *Petala* 5, sepalis alterna, eisdem multo breviora, spathulata, cucullata, membranacea. *Stamina* indefinita, libera; filamentis filiformibus; antheris complanatis, ovato- vel oblongo-ellipticis, muticis, marginelongitudinaliter dehiscentibus. Flores ♀: bibracteolati. *Calyx* tubo hemisphærico, ovario adnato, exalato, glabro; limbo perigyno, 5-partito, lobis tubo paulo longioribus vel eodem æquilongis, adscendentibus, ovatis, subacutis, longitudinaliter venosis, basi intus glandulis sparsis perigynis capitatis minutissimis (an staminodiis?) instructis. *Petala* 5, perigyna, calycis lobis alterna, parva, membranacea, oblanceolata vel spathulata, concava, circa ¾ lin. longa. *Ovarium* ⅔ inferum, subuniloculare, ut videtur tempore florifero apice hians; placentis 5, bifidis, liberis vel infra irregulariter inter se coalitis, utrinque ovuliferis. *Styli* late bifurcati, lobis erectis spiraliter stigmatosis. *Capsula* membranacea, hemisphærica, ad ½ unc. lata, indehiscens, vertice hians.

Collected in the island of Maui, Sandwich Islands, by Dr. Hillebrand, and communicated to the late Sir W. J. Hooker in July 1865.

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[*] For convenience, it may be allowable, in this and similar cases, to speak of the tube and limb of the calyx, although organogeny may prove that the former is an axial dilatation, and not a foliar development at all.

We have no information as to the size attained by this plant, nor as to its general habit, which, however, must entirely agree with that of very many true Begonias. The dried specimens sent home consist of leaf-bearing succulent branches, with well-developed inflorescence and fruit; and these abundantly suffice to settle all important points in its structure, which has appeared to me sufficiently remarkable to deserve illustration in the Society's Transactions.

Hillebrandia differs from all Begoniaceæ hitherto described in having an ovary with the upper one-third free and open above in the exserted portion, owing to the non-cohesion and divergence of the constituent carpels at the apex, as in *Datisca* and *Reseda*. A further difference of considerable interest, though perhaps not one to which equal importance ought to be attached, consists in the existence in the flower of petaloid organs which I cannot but regard as true petals, corresponding to the petals of most dichlamydeous flowers. These are the principal grounds upon which *Hillebrandia* is entitled to generic distinction. In other respects it is very closely allied to *Begonia*, and especially to *Mezierea* of Gaudichaud, which latter, however, presents a closer affinity with *Begonia* than with *Hillebrandia*. The special point of agreement between *Mezierea* and *Hillebrandia* consists in the placentation, which is parietal in both, the ovary being subunilocular, though with more or less cohesion below of the placentary plates. The symmetry of *Hillebrandia* is pentamerous in both sexes, that of *Mezierea* dimerous in the male, tetramerous or trimerous in the female flower. But this is unimportant, since the symmetry in this small order is very variable, one sex in the same species sometimes having the sepals quincuncial, while in the other sex the same organs are in decussating pairs.

The petaloid organs referred to above occur both in the male and female flower, and in precise alternation with the sepals. From this circumstance, together with their form and texture, I see no alternative but to regard them as petals. If this view be correct, the outer leaves of the perianth in this species must be regarded as sepals; and perhaps the inference may be extended so as to embrace the perianth-segments of the rest of the Begoniaceæ, which have been differently designated by different botanists—as sepals (Lindley), as sepals and petals (A. De Candolle), or as petals only (Klotzsch). The principal hesitation which I should feel in regarding the perianth-leaves of all *Begoniæ* as strictly homologous (using the term in a subordinate sense) with the sepals of dichlamydeous plants generally, arises from the various kinds of symmetry and evolution of parts which obtain in the order; so that, until similar petaloid organs shall have been found in flowers with a decussate development of their outer whorls, it may be the safer course to suspend judgment as to the *general* application of the terms sepal and petal in Begoniaceæ.

The remarkable character of an open ovary in a true Begoniacea is of peculiar interest in connexion with the question of the affinity of this isolated little Order. I think it must be sufficiently apparent that in this particular we have an important confirmation of the view, first definitely advanced by Dr. Lindley, that Begoniaceæ are nearly allied to Datiscaceæ (Veg. Kingdom, p. 316). It is perhaps in this very character of the gaping ovary (so far as floral structure is concerned) that the difference between the families has been hitherto the most marked. Between *Hillebrandia* and Datiscaceæ we find the following characters in common,—unisexual flowers, adherent ovary open above, with parietal multiovulate placentas, carpels opposed to sepals or perianth-segments, and a seed and embryo closely similar—most of them characters, with the exception of the open ovary now first described, already indicated by Dr. Lindley.

The seed and embryo in *Hillebrandia* and *Datisca* (the latter the only genus of Datiscaceæ of which I have examined well-developed seeds) are almost identical, agreeing in the areolate testa, and in the relative proportions of the cotyledons and radicle of the exalbuminous embryo.

As occasionally happens when new plants turn up illustrating affinities in this way, we have found, mingled in *Hillebrandia* with these characters so strongly inclining towards Datiscaceæ, another character (that of the existence of true petals) apparently pointing in a different direction. This character does not, however, appear to warrant any new or decided opinion in respect of the affinities of Begoniaceæ, neither weakening nor particularly strengthening the views which have hitherto met with most favour. It must be borne in mind that in the female flower of *Datisca*, according to M. Payer*, the three inner perianth-segments (which alternate with the three outer, forming a sex-partite perianth, in the male) are arrested at a very early stage of development, ... "à peine nées s'atrophient et l'on n'en aperçoit bientôt plus aucune trace."

DESCRIPTION OF THE PLATE.

Plate XLVI.

Fig. 1. Male flower, laid open so as to show the petals.
2. Single stamen of the same.
3. Female flower, with pair of bracts.
4. The same laid open, showing the petals and minute capitate glands (which can hardly be regarded as staminodia?) scattered along the line of insertion of the calyx-lobes.
5. Transverse section of ovary.
6 & 7. Style, back and front.
8. Single petal, and one of the perigynous glands (?), of the female flower.
9. Mature capsule.

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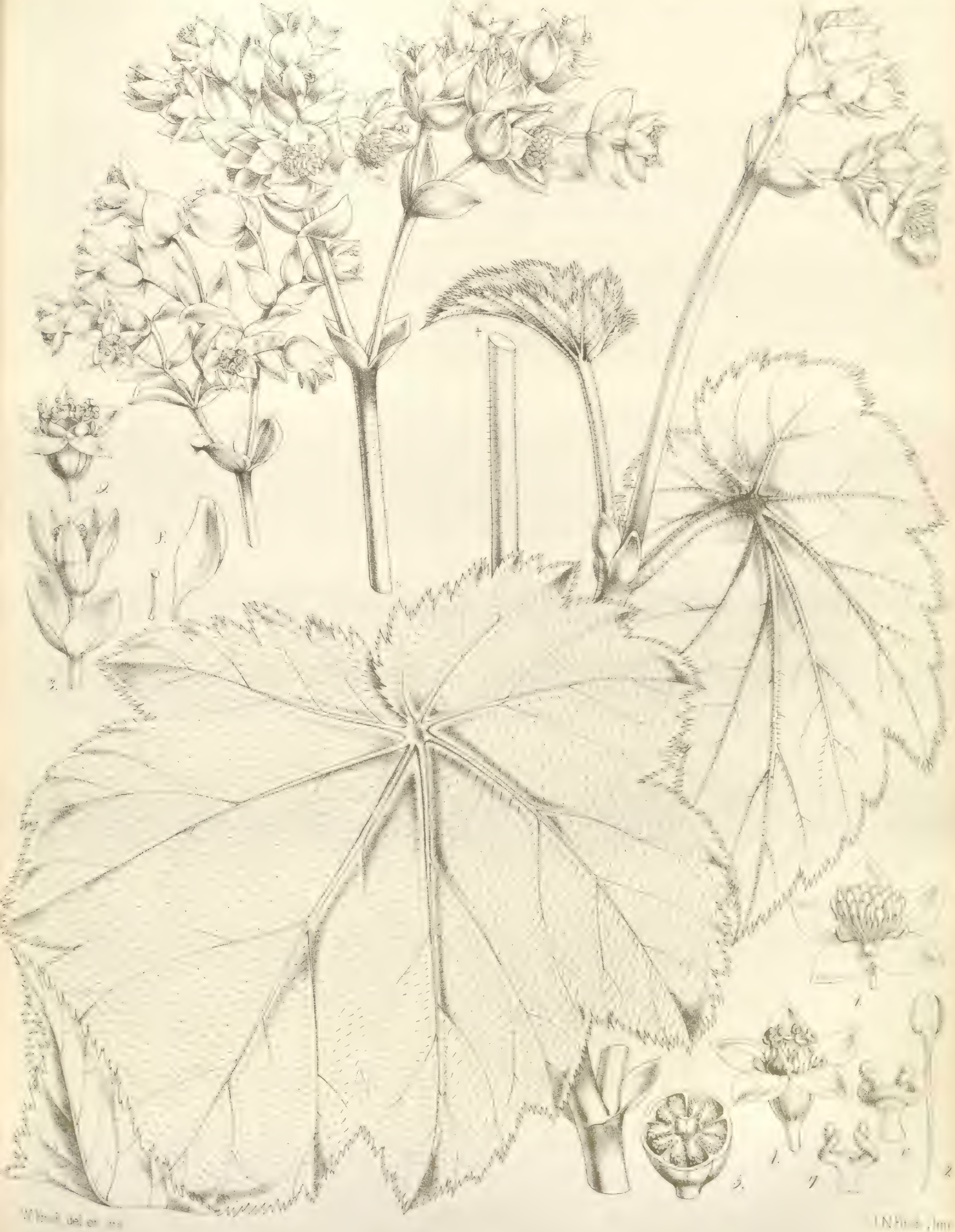
* Organ. Végétale, p. 372, t. 81, quoted also by A. DeCandolle, Prod. xv. 410.



W. Fitch del. et lith.

J.N. Fitch Imp.

Hillebrandia sandwicensis, Oliv.

XII.—*On the Spicula of the Regular* Echinoidea. *By* CHARLES STEWART, *Esq.* *Communicated by* Professor HUXLEY, *F.L.S.*

(Plates XLVII., XLVIII., XLIX., L.)

Read November 16th, 1865.

THE subject of the present paper is an account of those calcareous bodies that are found imbedded in certain parts of the perisoma of the Echinoidea, and also in the membrane and its reflections that line the interior of their shells. They are generally to be found in the external branchiæ and ambulacral tubes, and internally in the madreporic canal, ovaries, intestine, and mesentery, and sometimes in the ambulacral vessel and the membranes and ligaments about the base of the jaws.

Although the forms of the spicula of the Cirrho-vermigrade Echinodermata have been found to be of the greatest value in the determination of species, but little notice has been taken of them in the regular Echinoidea.

Valentin, in his monograph on the genus *Echinus*, mentions their occurrence in various parts, and gives M. Miescher as an authority for their being found in the ovary, but strangely remarks that "it remains to be proved whether these little calcareous bodies are artificial products, or exist as well in the living animal." He figures those of the external branchiæ of *Echinus lividus*, and of one called by him *E. brevispinosus*, which, however, I believe is identical with *E. Dröbachiensis* of our northern coasts, the spicula, which are very peculiar, being identical with those of that species; and I have since been confirmed in this opinion by Dr. Herapath, of Bristol, whose examination of the pedicellaria led him to a similar conclusion.

These spicula vary greatly in the amount of their development in different genera and species; and in this respect, as well as in their different forms, they will, I believe, be found to afford most valuable and interesting additional points of generic and specific distinction.

The bihamate is the usual shape they present. Such are figured by Valentin, mixed with reticulated plates as they occur in the external branchiæ; to these must be added perforated or reticulated plates often attaining a large size, having irregular or smooth margins, and triradiate, acerate, biclavate, bihamate, and irregularly branched or curved spicula. In many, more especially in those of the bihamate form, there is a great tendency to the formation of a spheroidal enlargement at the centre, which sometimes, by increased development, forms a spine projecting either from their concave or convex border; many specimens seem to show that this spheroidal body is often first formed, and that from it the other parts of the spiculum are subsequently extended. Between all these forms intermediate conditions can be found, by which their identity in structure and mode of development with the other shelly parts can be clearly demonstrated. The striking resemblance to the spicula of Sponges and to those of some Mollusca, from which many, particularly those of *Echinometra*, could not, I think, be distinguished, seems to point to a similar mode of development of the skeleton in these widely separated members of the animal kingdom.

With regard to the intimate structure of these spicula, I may mention that many, when mounted in balsam, present a much paler appearance than others, probably owing to their possessing a less refractive power, and that many apparently identical, when examined by polarized light, show a total absence of depolarizing property which in others is well marked, and also that the spicular plates of *Cidaris* frequently have their two halves in a state of tension, the one at right angles to the other, although no other evidence of structural difference can be detected.

The proportion of animal matter varies considerably—charring frequently demonstrating a line of it running through the centre of the spicula, such as is found in those of the *Spongiadæ*.

It would perhaps be interesting to those who may be desirous of extending these observations, to describe briefly the means used by me in investigating these structures.

As all the Echinoidea I examined were in the dry state, and had been for the most part preserved for a long time in museums, their softer parts were covered with mould, which could only be removed by very careful washing under water with a camel's-hair pencil: liquor potassæ does not dissolve this fungus; besides, its use would only show the separate forms of the spicula; it can, however, be advantageously employed in some instances.

The membranes so cleaned were then dried on a slide, and mounted in balsam in the ordinary way.

As specimens of the genus *Cidaris* are rare and generally preserved whole, it is difficult to procure examples of their internal parts; those of my own cabinet I partially sacrificed by removing the anal plates of those in which the oral surface was most perfect, and *vice versâ*: by this means the whole of the viscera, &c., could be obtained without much injury.

After these general remarks I now proceed to a description of the various modifications these spicula present in the different genera I have examined.

In *Cidaris* the ovaries, or testes, contain perforated plates, which, in the membranes of the base, often attain the $\frac{1}{16}$th of an inch in diameter, and are so crowded as to overlap each other. Owing to the rigidity imparted by their presence, the ovarian tubes retain their shape in old and dry specimens. Similar plates sometimes extend laterally on each side of the ovarian branches, and in a more delicate form are found in the fibrous bands that frequently terminate or connect the branches together (Plate XLVII. figs. 1, 2, 3). Their shape is usually irregularly ovate; but in *Cidaris tribuloides*, in which the ovary is converted into a solid organ by the union of its parts, the plates are evidently formed on a triradiate type (Plate XLVII. fig. 5). In another species a portion of the plate projected as a spine (Plate XLVII. fig. 4). I have only found one exception to this condition of the ovary—in a small *Cidaris* from Malta, in which all the internal parts examined were devoid of spicula, although the ambulacral tubes possessed similar ones to those of other *Cidaridæ* (Plate XLVIII. fig. 12); the species probably really belongs to the genus *Orthocidaris* of Agassiz.

In the walls of the intestine there are numerous small plates having irregular or smooth margins (Plate XLVIII. figs. 1, 2, 3).

In the mesentery they are usually large, and in some species have an acicular or triradiate character (Plate XLVIII. figs. 4, 5); a superficial layer of irregular, generally delicate, reticulate spicula is frequently found on the surface of the mesentery, from which it can be easily removed, when, owing to their interlacing, its character as a membrane is retained (Plate XLVIII. fig. 6). Where the mesentery is united to the intestine, and on the inner border where the loops of intestine are strengthened by a free membrane, the plates assume the form of spines projecting from the membrane, in which their bases are inserted; they have generally a solid axis, with a dextrally spiral arrangement of the areolæ on their surface (Plate XLVII. figs. 6, 7, 8, 9).

The membranous and ligamentous bands at the base of the lantern are generally abundantly supplied with spicula; in the one which extends inwards from the transverse muscle they are sometimes of large size, interlocking and overlapping by their lateral processes (Plate XLVIII. figs. 9, 10); this membrane has sometimes a tuft of spines on its inner border (Plate XLVII. fig. 10).

The spicula of the ambulacral tubes are most numerous towards their free extremity, and lie transversely to their length, are curved to adapt them to their cylindrical form, smooth on the concave and with rings of short spines on their outer or convex border; they are frequently branched or acicular in character, these more irregular forms being usually of less refractive power. The dorsal ambulacral tubes have the spicula reduced to a few irregular calcareous threads; and the rosette, &c., which in the oral ambulacral tubes is well developed, is here represented by a few delicate plates of indefinite form (Plate XLVIII. figs. 11, 12).

In *Goniocidaris* the walls of the intestine are crowded with triradiate spicula, having their points generally rounded, although frequently one is produced as a sharp curved spine projecting at an angle of 45° to the plane of the others (Plate XLVIII. fig. 13); towards the edge of the intestine they assume the form of perforated plates, but show well-marked evidence of their triradiate origin (Plate XLVIII. fig. 14). As in *Cidaris*, the intestine is fringed by spines along at least one of its borders; they are, however, more slender than in that genus; and the basal plate from which they spring being narrow and much produced makes them resemble the letter T (Plate XLVIII. fig. 15).

In the ovaries they are very abundant, and coarser than in other parts, but retain the same triradiate plan of growth. (Plate XLVIII. fig. 16, *b*.)

The spicula of the ambulacral tubes differ but little from those of *Cidaris*; they are, however, much smaller, and somewhat more branched and spinous in proportion to their size, than is generally the case in that genus. (Plate XLVIII. fig. 16, *a*.)

In *Diadema* the intestine has imbedded in its substance a very few small irregularly curved and sometimes branched spicula, having often an enlargement about the centre (Plate XLVIII. fig. 18, *a*); in a membrane obtained from near the anus I found similar spicula, but much larger and more numerous (Plate XLVIII. fig. 17, *b*.); in a small *Diadema* from China they were much branched, and often on a triradiate type (Plate XLVIII. fig. 18, *b*).

The ambulacral tubes are abundantly supplied with spicula, usually triradiate, but larger and more irregular towards their free extremity. (Plate XLVIII. fig. 17, *a.*)

In the ovary I have as yet been unable to detect any.

In *Echinometra* the spicula are perhaps the most interesting of any, both from their great variety and number, and from the transitional forms they present between straight, hooked, and triradiate spicula, and perforated plates.

The ovary is crowded with bundles of long acerate spicula resembling those of many sponges; from the sides of these frequently project secondary processes, which, reuniting to it, convert the spiculum into a perforated plate; bihamate spicula and small plates of various forms are also abundantly scattered through its substance. (Plate XLIX. figs. 1, 2.)

In the intestine and its free inner membrane are numerous small plates and hooks, varying in their proportionate number in different parts, and in shape and dimensions in the species. (Plate XLIX. figs. 3, 4, 5, *a*, *b.*)

The mesentery also is abundantly supplied with spicula, having their long axes in the direction of its fibres, and often closely resembling those of the ovary. (Plate XLIX. figs. 3, 4, 5, *c.*)

The spicula of the ambulacral tubes are generally of the bihamate variety, differing in size and amount of curvature in the various species, and having sometimes the form of a ring, owing to the union of their points. In one specimen triradiate spicula were found at the base of the ambulacral tubes; but these may be the spicula of a sponge accidentally entangled amongst them, although every available precaution was taken to prevent such an accident, and in this species the spicula of the ovary and mesentery presented a more than usual tendency to that form. (Plate XLIX. fig. 6.)

In the genera previously described the principal variations in the form of the spicula occurred in the internal parts, those of the ambulacral tubes and branchiæ undergoing but few modifications; in the genus *Echinus*, however, the internal spicula are always of the bihamate form, varying only in their size and curvature, and the amount of development of the central nodule; sometimes, also, one of the hooks is repressed or reversed (Plate L. figs. 2, 3, 5, *b*, *c*); they are generally most numerous in the ovaries, pharynx, and œsophagus; in the madreporic canal they are also abundant.

The spicula of the ambulacral tubes and external branchiæ, from the former of which they are sometimes entirely absent, present, however, great diversities of shape and dimensions, although in most the bihamate type prevails. Plate L. fig. 2 *a* is the most frequent form; fig. 3 *a* are those of *E. Dröbachiensis*, described by Valentin under the name of *E. brevispinosus*, and *E. neglectus* by Forbes; the plane hooks are found immediately behind the terminal rosette.

The largest and strangest spicules I have yet found occurred in a small, long-spined specimen from India (Plate L. figs. 1, 4), which, although labelled "Echinus," evidently does not belong to that genus, but seems to answer more to the description of *Heliocidaris* given by Dujardin and Hupé.

They are found in the ambulacral tubes, in which they arise as irregular, finely spinous, perforated plates, by the thickening of which the perforations are converted into tubes more or less branched, running from side to side of the spiculum; they open on the surface in the depressions between the spines; the smaller hooked spicula are occasionally found at the base of the ambulacral tubes. In a fragment of membrane obtained from the interior of the shell, delicate branched spicula were found in moderate abundance.

The spicula of an *Echinus* (*Tripneustes**) from the New Hebrides, and called by the natives Nĕhvei, are also extremely interesting, as they approximate in character the miliary and tentacular spicula of *Synapta* and *Chirodota*, in which the dumb bells, passing into the hooked condition, are of such frequent occurrence: their various forms are shown in Plate L. fig. 5, *a*; and in Plate L. figs. 10, 11, the spicules of *Chirodota* and *Synapta* are figured for comparison.

Although in *Acrocladia* the test and spines attain so great a size, the spicula are very scanty in comparison with most other genera. Those of the ambulacral tubes are about as numerous as in *Echinus*; they are, however, more long and straight, with abruptly curved points (Plate L. fig. 6, *a*). I have not been able to find any in the ovaries or intestine; but the ambulacral vessel contains some similar to those of the internal parts of *Echinus*.

In *Podophora* I have found spicula only in the ambulacral tubes, not differing from those of *Echinus*, although I had abundance of the internal parts for examination, showing in this respecta greater affinity to *Acrocladia* than *Echinometra*, in which genus it used to be included. (Plate L. fig. 7.)

In *Mespilia* spicula were found in the ambulacral tubes and ovaries; they were of the bihamate form, large, but slender. (Plate L. fig. 8.)

Bihamate spicula were also found in a fragment obtained from the exterior of the shell of a *Temnopleurus*: they were mixed with irregular perforated plates; so it may probably be considered a portion of the external branchiæ, in which such plates are, I believe, of constant occurrence in most, if not all, of the genera in which these organs are present. (Plate L. fig. 9.)

I was unable to find any in *Arbacia*, although the ambulacral tubes, intestine, and ovaries were examined with great care.

I have only, in concluding, to return my most sincere thanks to Dr. Gray and Mr. Flower for the kindness with which they permitted me to examine the valuable specimens in their charge; nor can I fail to record my obligations to the late Mr. S. P. Woodward, who most freely allowed me to study those of his private collection.

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* Since the above paper was read, I find that the *Echinus* from the New Hebrides really belongs to the genus *Tripneustes*. *E. Dröbachiensis* is also placed with *E. lividus*, &c., in that of *Toxopneustes*. The propriety of this, together with some other subdivisions of the old genera *Echinus* and *Cidaris*, seems to me, however, to be doubtful.

DESCRIPTION OF THE PLATES.

Plate XLVII.

Fig. 1. Portion of ovarian tubes, *Cidaris grandis.*

Figs. 2, 3. Extremities of ditto, showing terminal and connecting fibrous bands.

Fig. 4. Extremity of ovarian tube, *Cidaris* —— ?

Fig. 5. Spicula from ovary of *Cidaris tribuloides.*

Fig. 6. Fringe of spines along the inner border of the intestine of *Cidaris grandis* (in situ).

Fig. 7. Spines from the mesenteric border of ditto.

Fig. 8. Spines from the inner border of ditto.

Fig. 9 *a*. Spine from mesenteric margin of *Cidaris* —— ?; *b*, from inner border, showing its solid axis.

Fig. 10. Spines from interradial membrane at the base of the lantern of *Cidaris tribuloides.*

Plate XLVIII.

Fig. 1 *a*, *b*. Different portions of intestine of *Cidaris grandis* (spicula *in situ*).

Fig. 2. Ditto *Cidaris* —— ?

Fig. 3. Ditto *Cidaris tribuloides.*

Fig. 4. Portion of mesentery of *Cidaris* —— ? (spicula *in situ*).

Fig. 5. Ditto *C. tribuloides.*

Fig. 6. Superficial layer of spicula from the mesentery of *C. tribuloides.*

Fig. 7. Spicula *in situ* from free inner membrane of *C. tribuloides.*

Fig. 8. Ditto *Cidaris* —— ?

Fig. 9. Plate from interradial membrane of *Cidaris* —— ?

Fig. 10. Spicula of external oblique ligament of lantern of *Cidaris* —— ?

Fig. 11. Spicula from an ambulacral tube of *C. tribuloides.*

Fig. 12 *a*. Ditto from ambulacral tube of oral surface of *Cidaris* from Malta; *b*, ditto from dorsal surface.

Fig. 13. Spicula of the intestine of *Goniocidaris geranoides* (in situ).

Fig. 14. Spicula from its inner border.

Fig. 15. Spines from border of intestine.

Fig. 16 *a*. Spicula from ambulacral tubes; *b*, from ovary.

Fig. 17 *a*. Spicula from ambulacral tube of *Diadema*; *b*, from internal membrane near the anus (*in situ*).

Fig. 18 *a*. Spicula of intestine of same *Diadema*; *b*, ditto *Diadema* from China.

Plate XLIX.

Fig. 1. Spicula from the ovary of *Echinometra* (D. 153 Royal Coll. Surgeons).

Fig. 2. Ditto *Echinometra*, Wh.

Fig. 3 *a*. Spicula of intestine; *b*, inner margin; *c*, mesenteric band of *Echinometra*, D. 153 (*in situ*).

Fig. 4 *a*, *b*. Spicula of different parts of the intestine of *Echinometra*, Wh. (*in situ*); *c*, from mesentery.

Fig. 5 *a*. Spicula of intestine; *b*, inner border (*in situ*); *c*, from mesentery of *Echinometra*, Ol.

Fig. 6 *a*. Spicula of ambulacral tube of *Echinometra*, D. 153; *b*, ditto *Echinometra*, Wh.; *c*, *Echinometra* from China, *d*, E. Ol.

Plate L.

Fig. 1. Spicula from ambulacral tube of *Heliocidaris* ?

Fig. 2 *a*. Spicula from ambulacral tube of *Echinus sphæra*; *b*, from ovary.

Fig. 3 *a*, *b*. Ditto, ditto, *E. Dröbachiensis.*

Fig. 4 *a*. Edge of large spiculum of *Heliocidaris*, showing the tubular and reticulate character of the areola; *b*, side view of smaller spiculum; *c*, Hooked spicula from base of ambulacral tube.

Fig. 5 *a*. Spicula from the ambulacral tube; *b*, internal membrane from near the anus; *c*, from ovary, of *Echinus* from Aneiteum, New Hebrides.

Fig. 6 *a*. Spicula of an ambulacral tube of *Acrocladia trigonaria*; *b*, from ambulacral vessel.

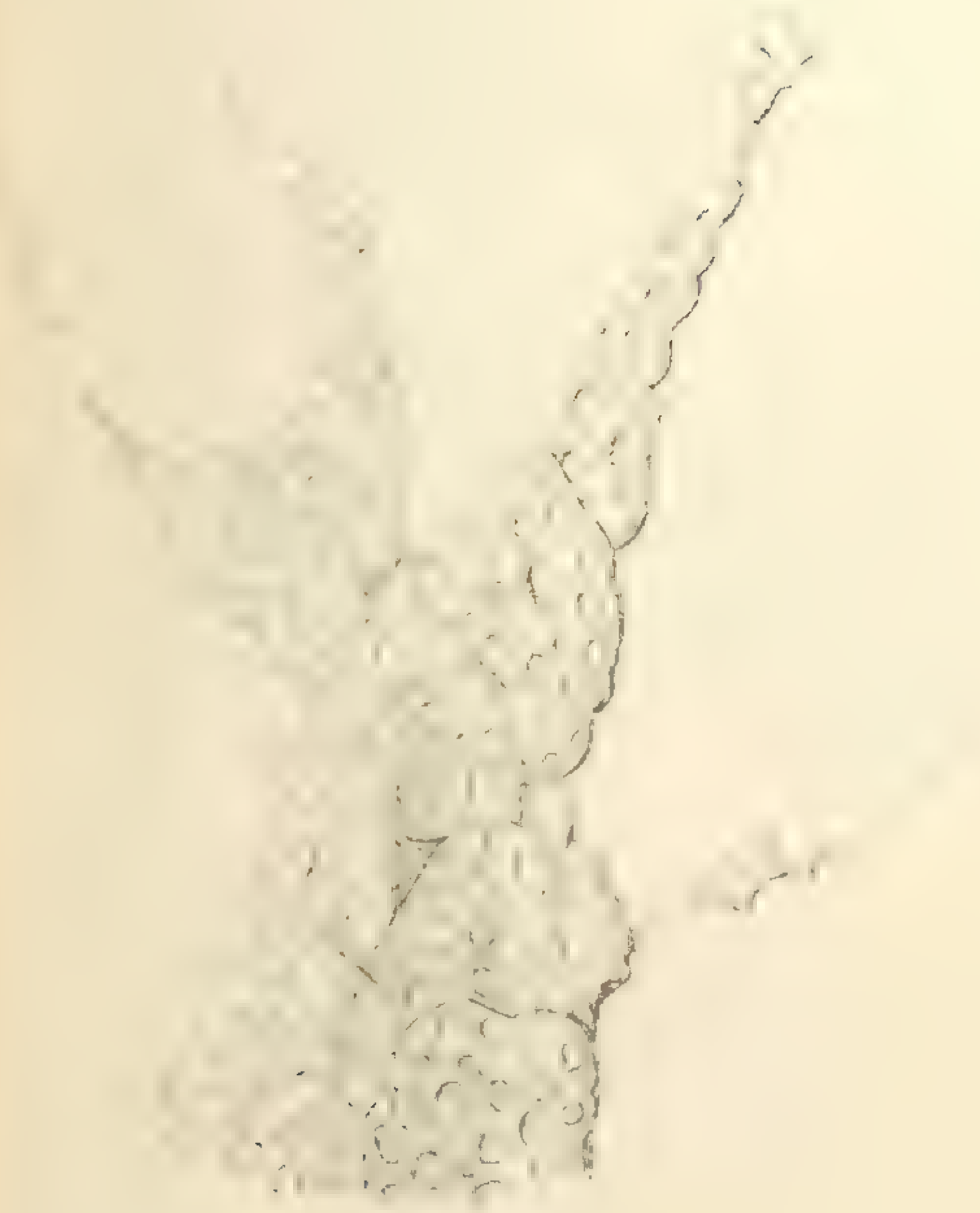
Fig. 7. From ambulacral tube of *Podophora atrata.*

Fig. 8 *a*. From ambulacral tube; *b*, intestine; *c*, ovary of *Mespilia.*

Fig. 9. Spicula from *Temnopleurus.*

Fig. 10 *a*. Tentacular (?) spicula of *Chirodota*; *b*, *Synapta*, from Japan.

Fig. 11 *a*. Miliary plates of *Synapta inhærens*; *b*, ditto *Synapta* from New Zealand; *c*, ditto *Synapta digitata*; *d*, *S. bidentata* (*c* & *d*, after Woodward and Barrett).



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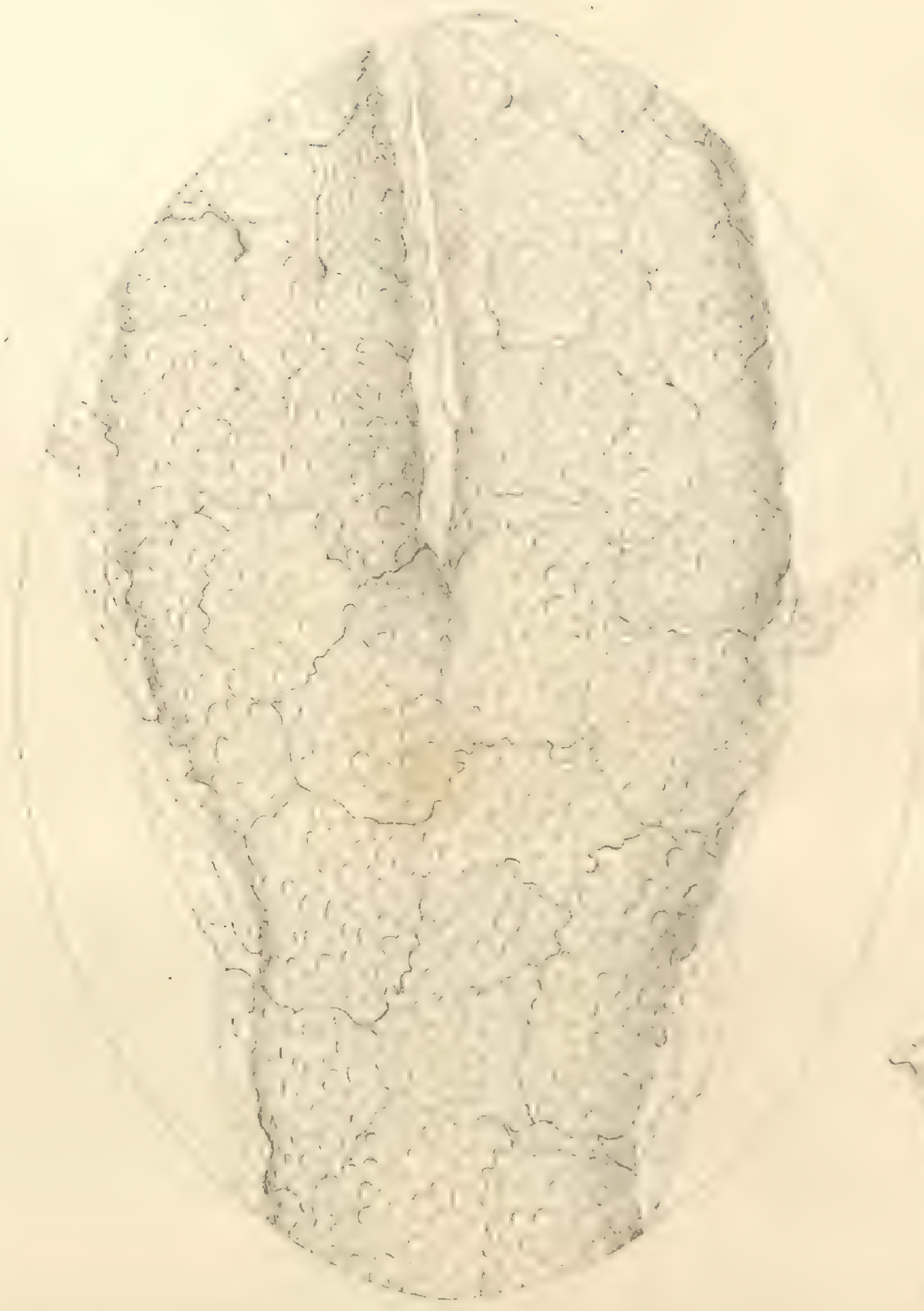

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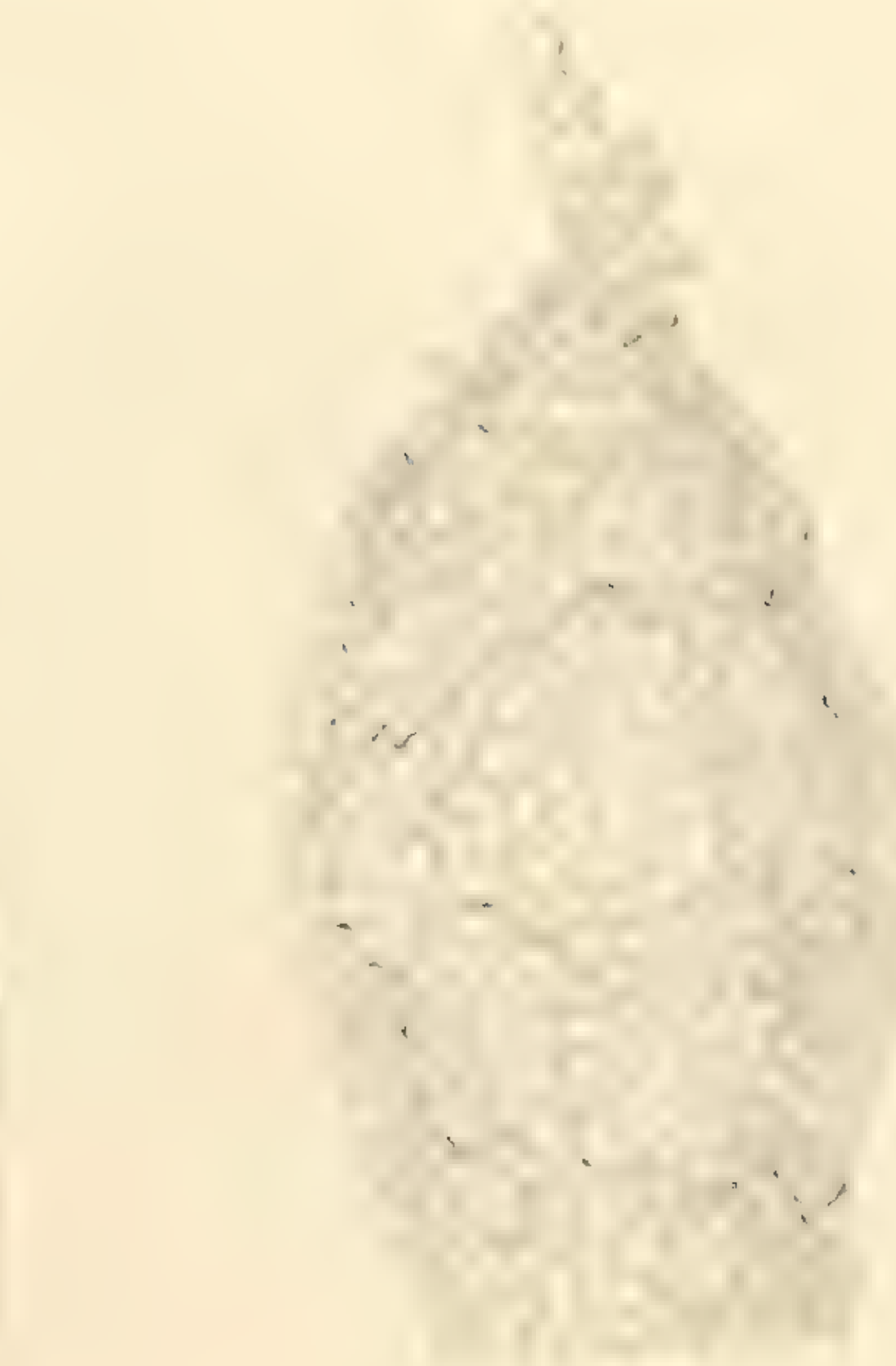

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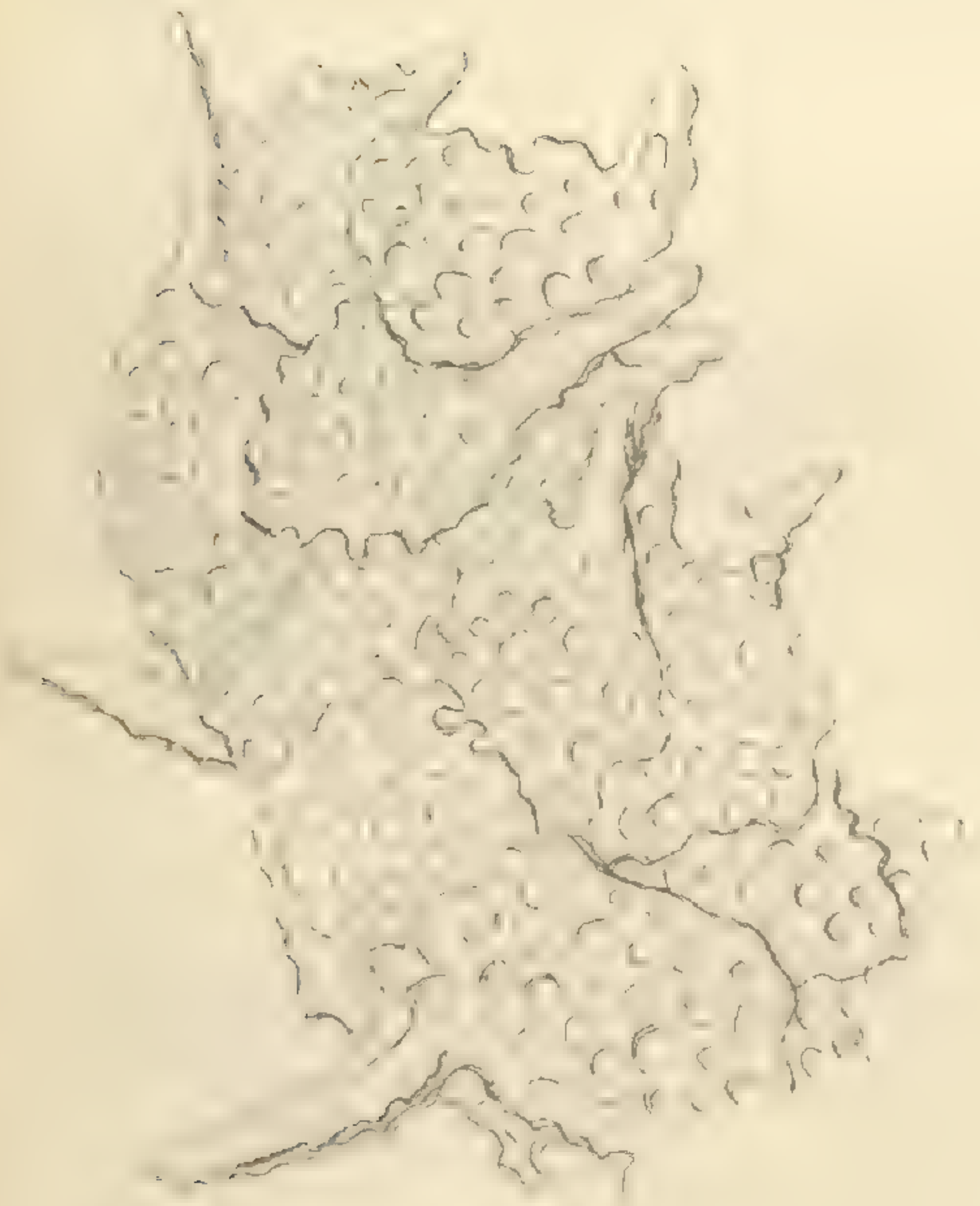

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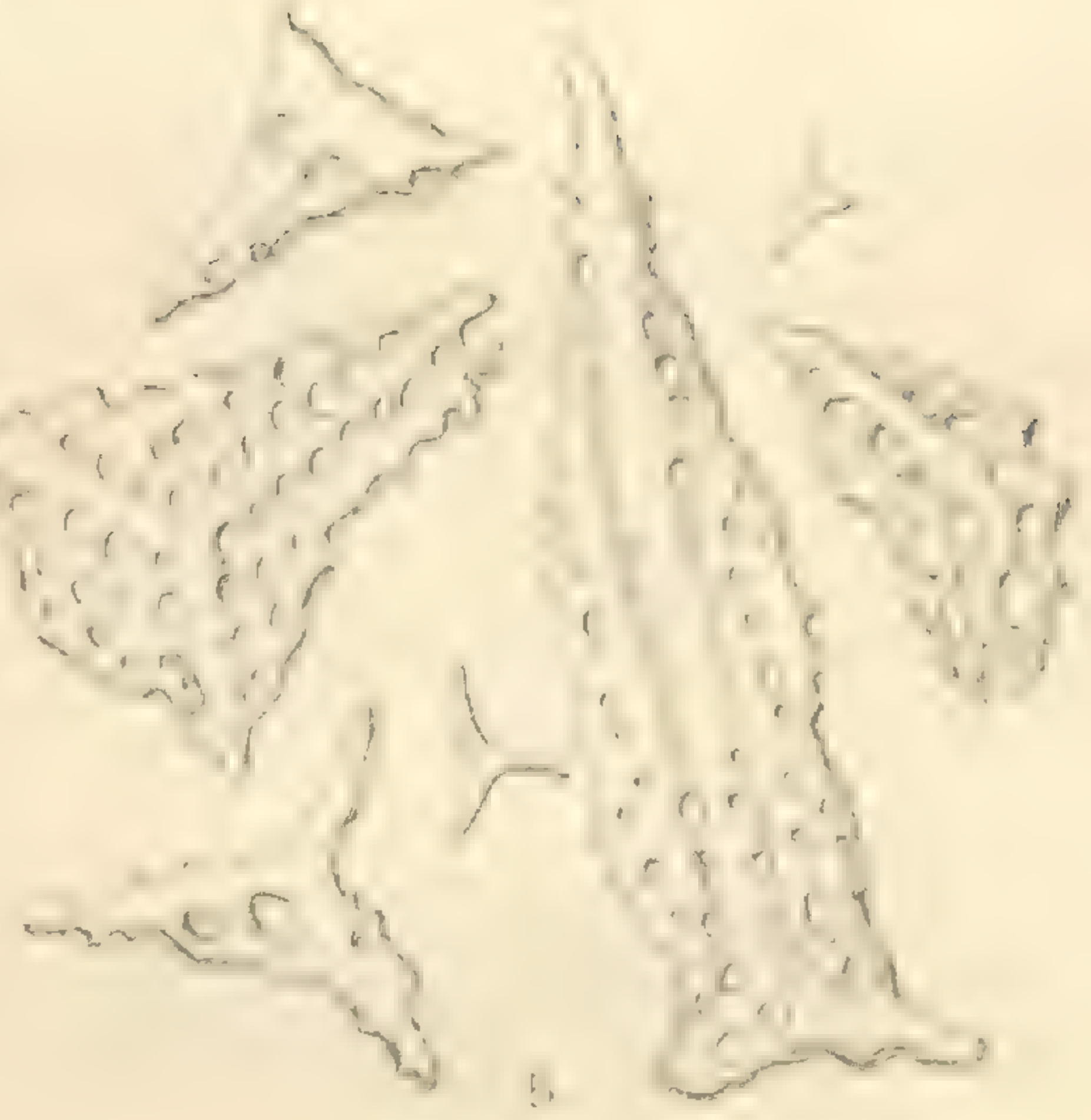

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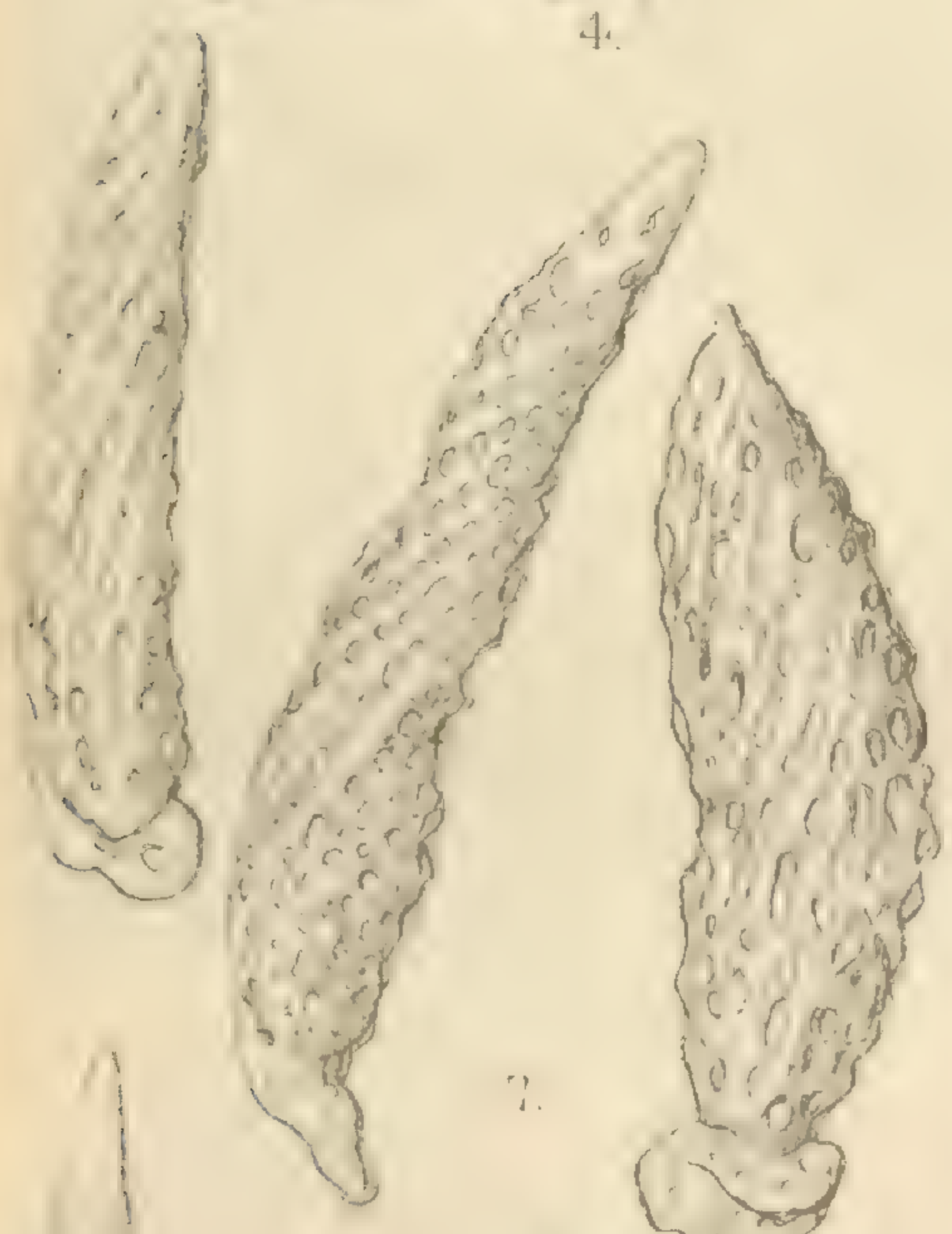

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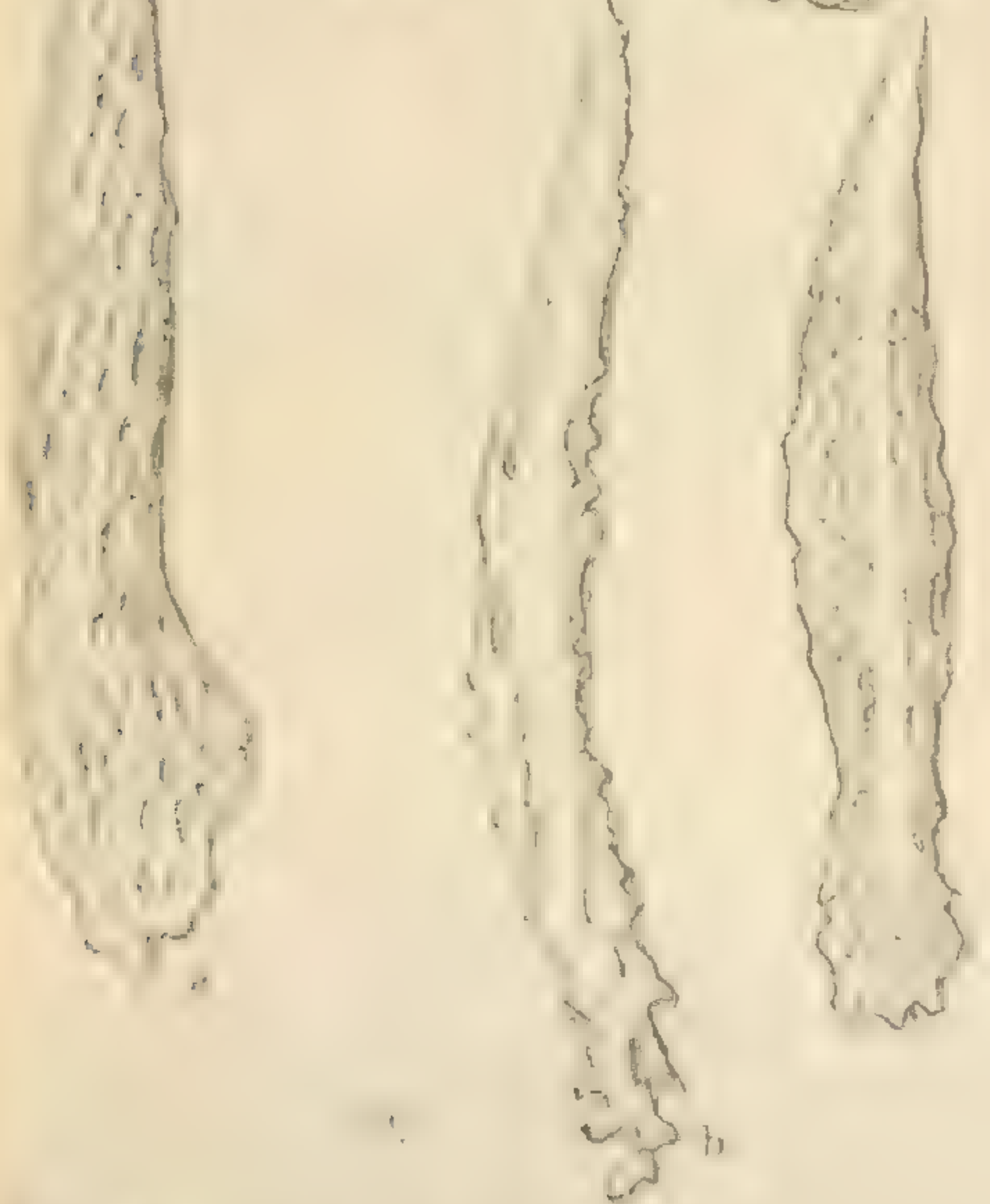

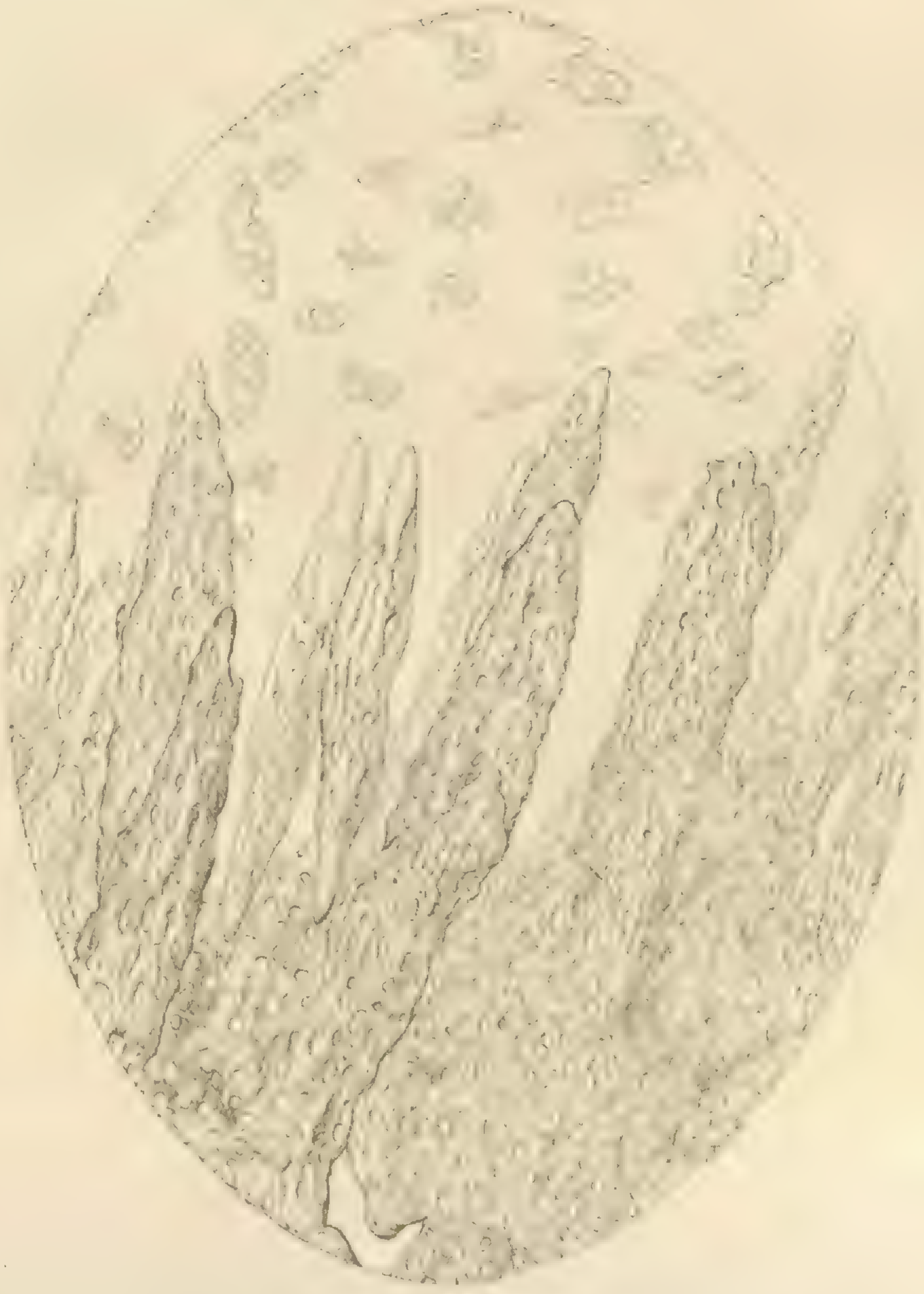

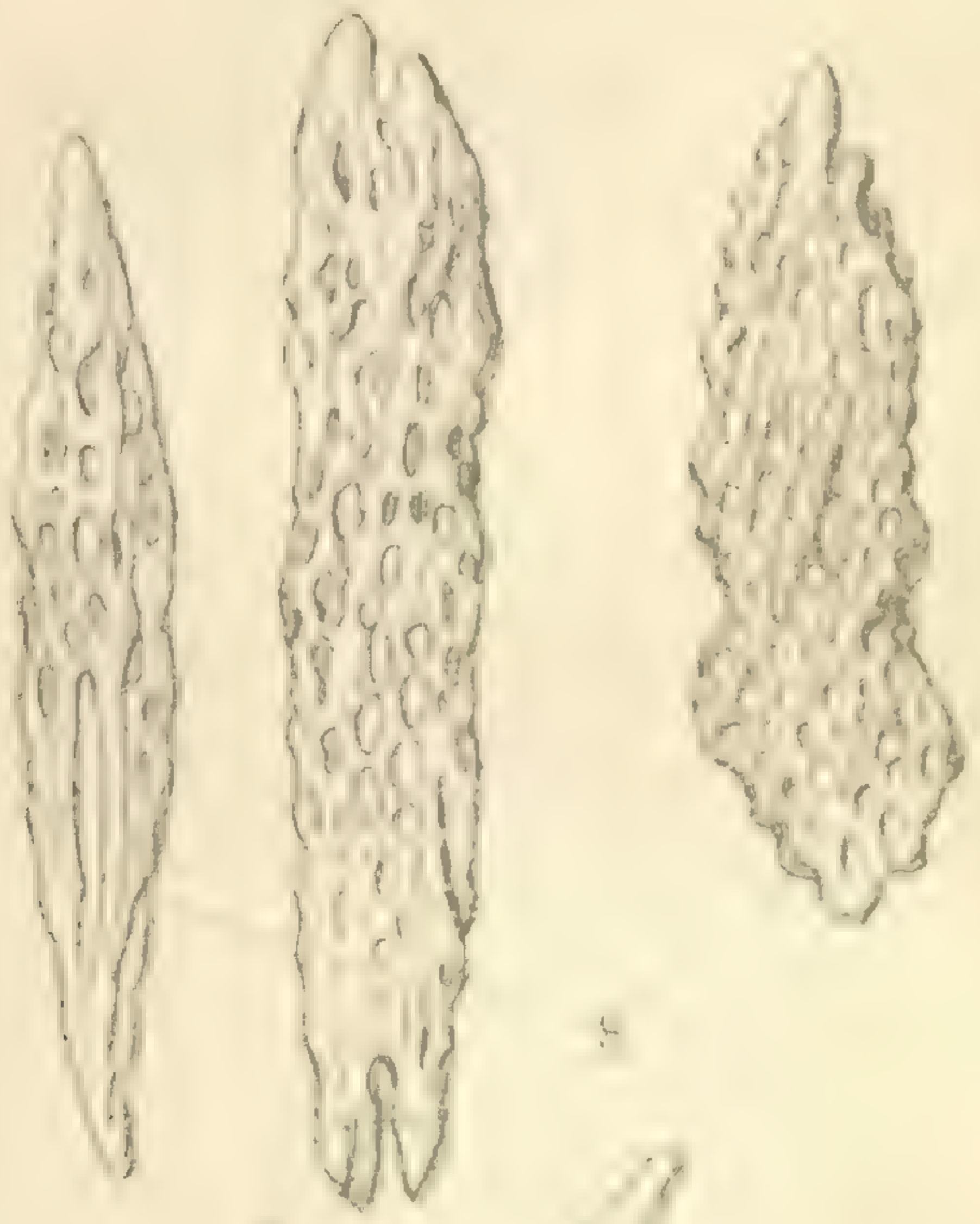

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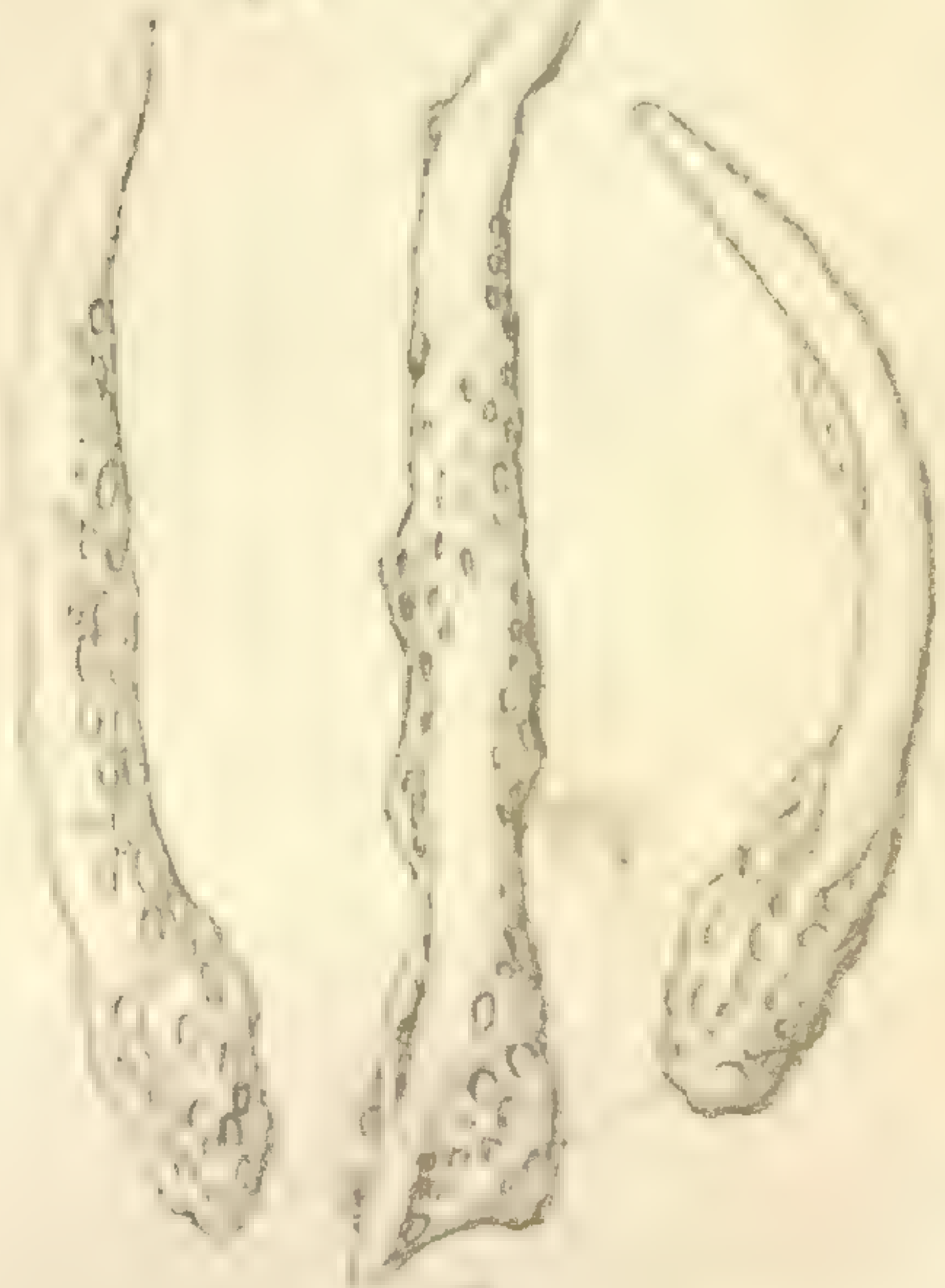

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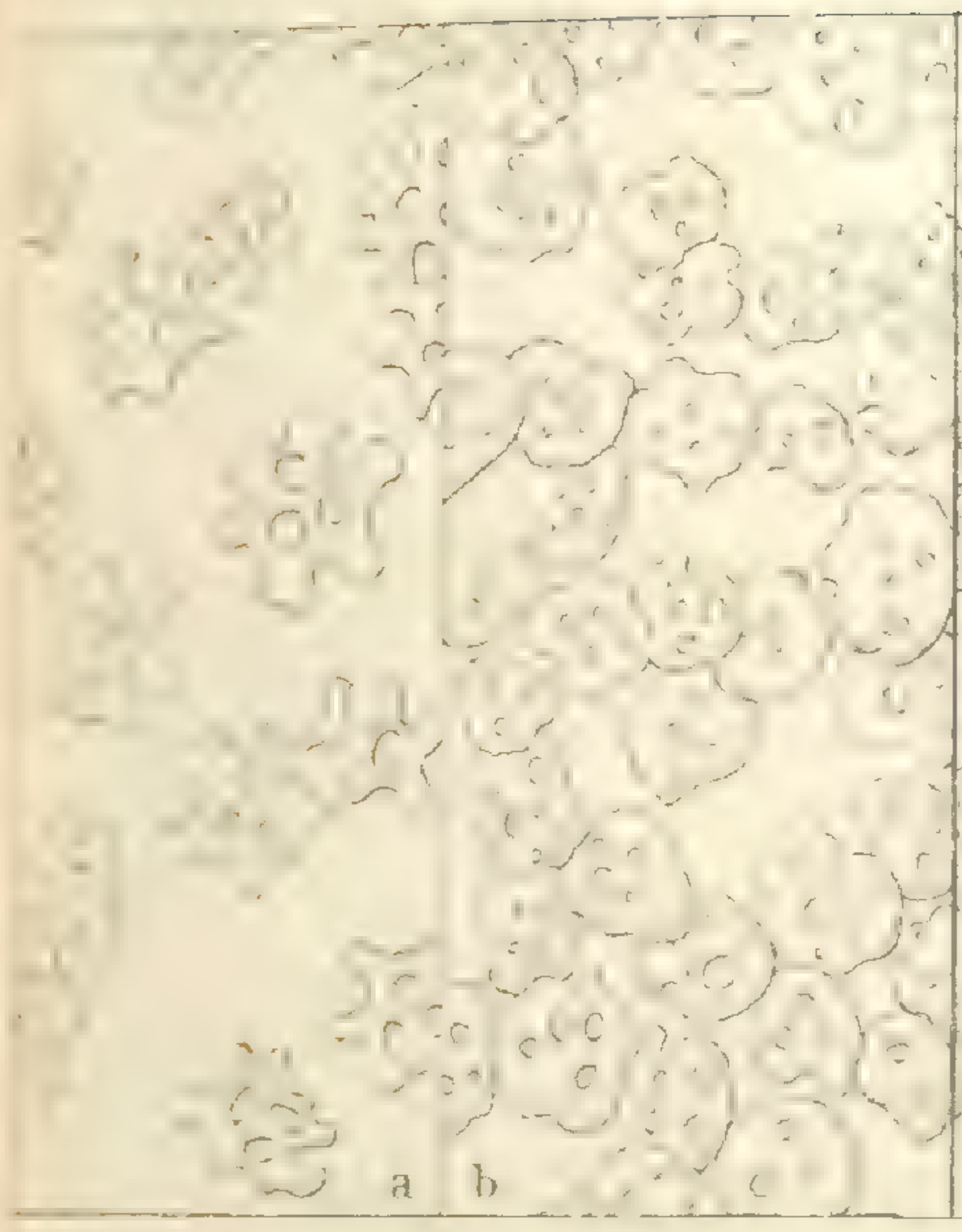

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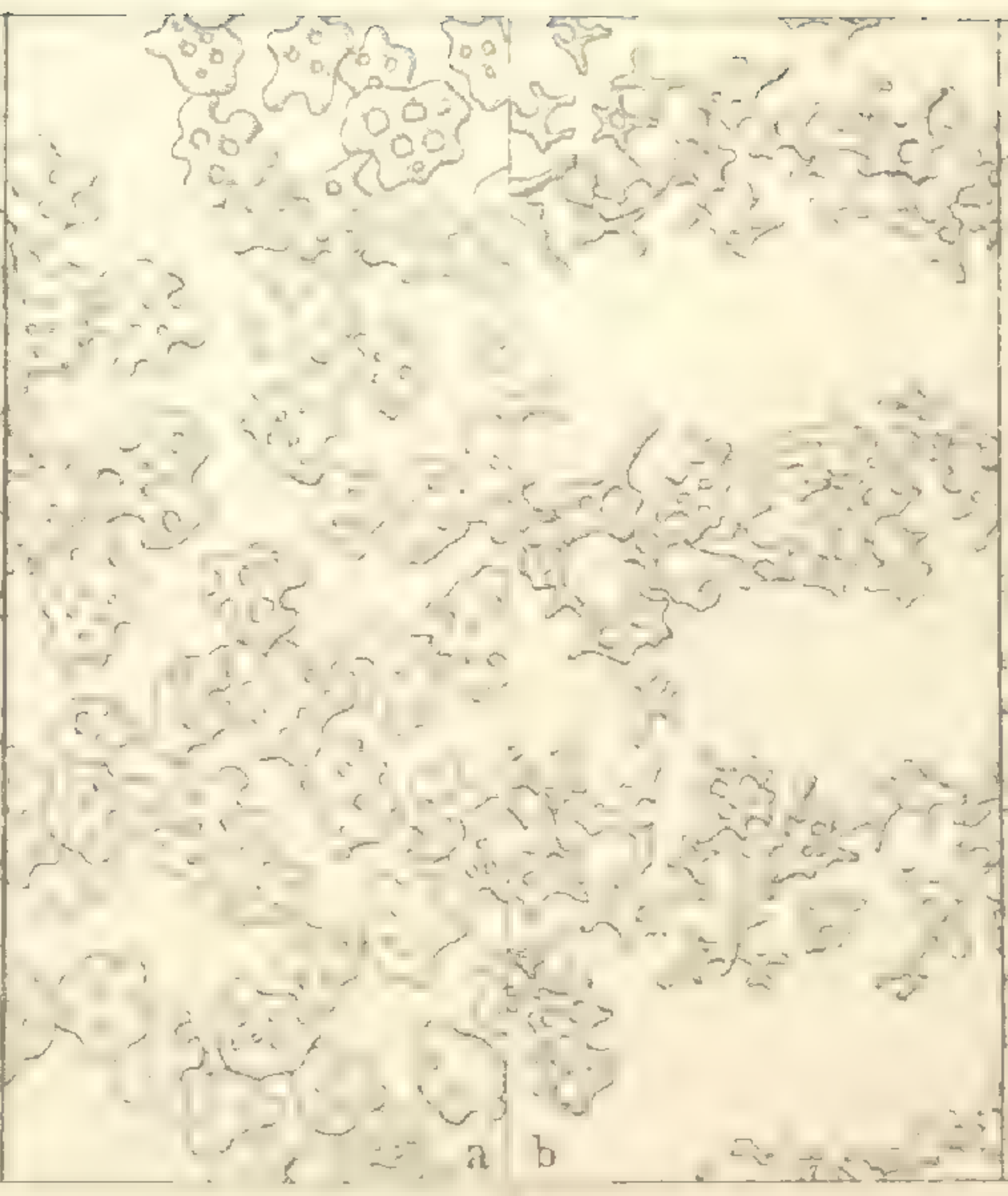

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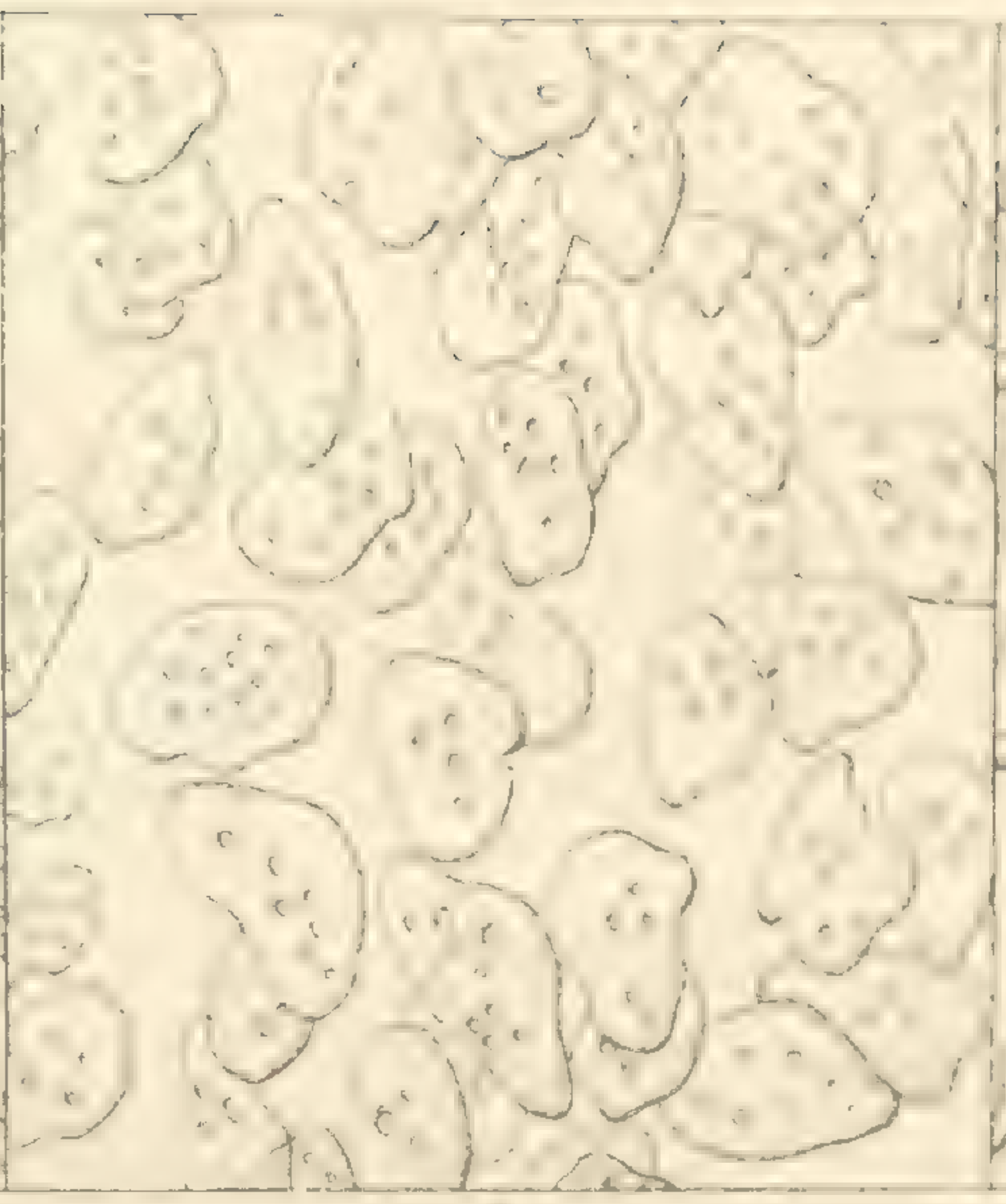

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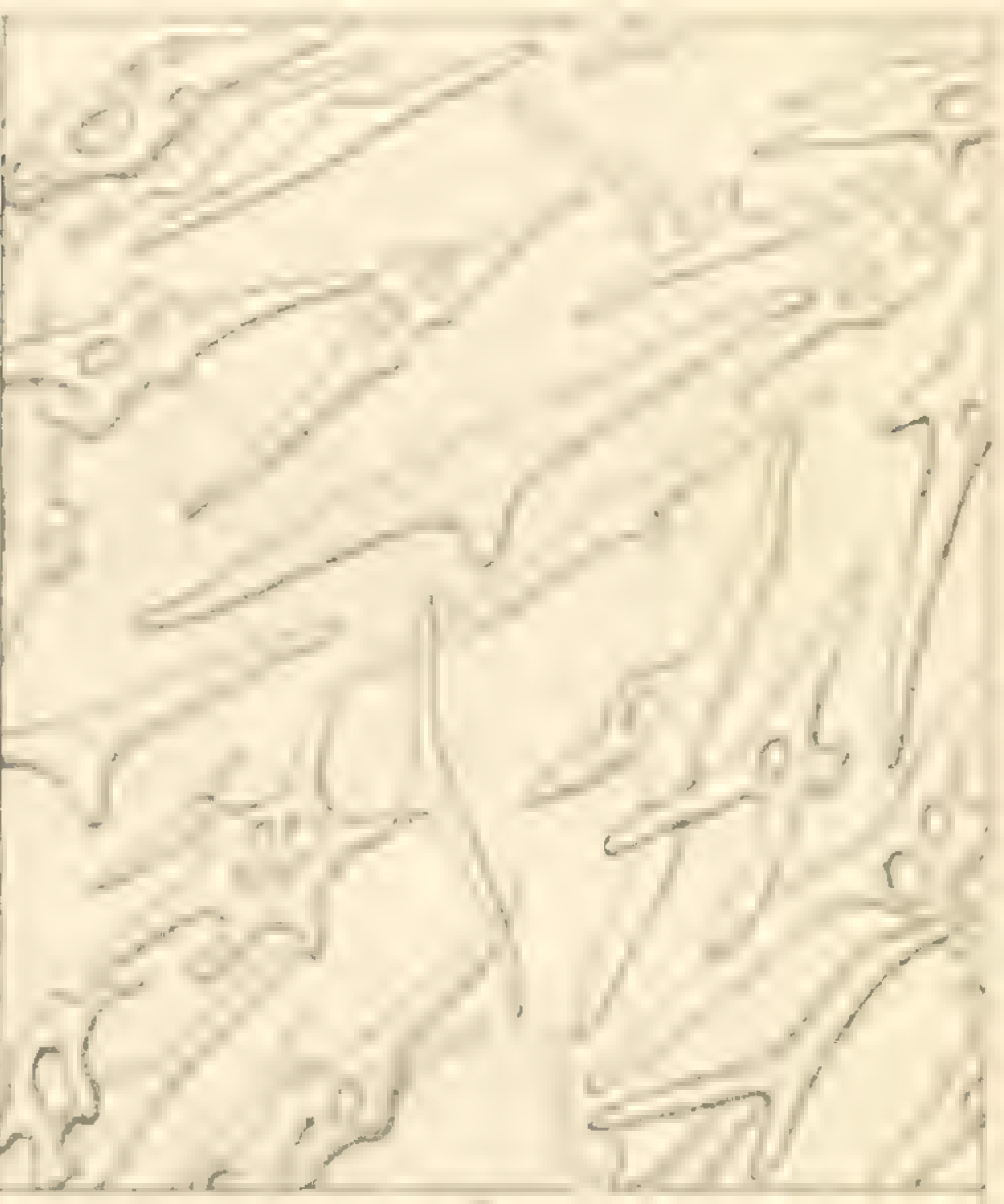

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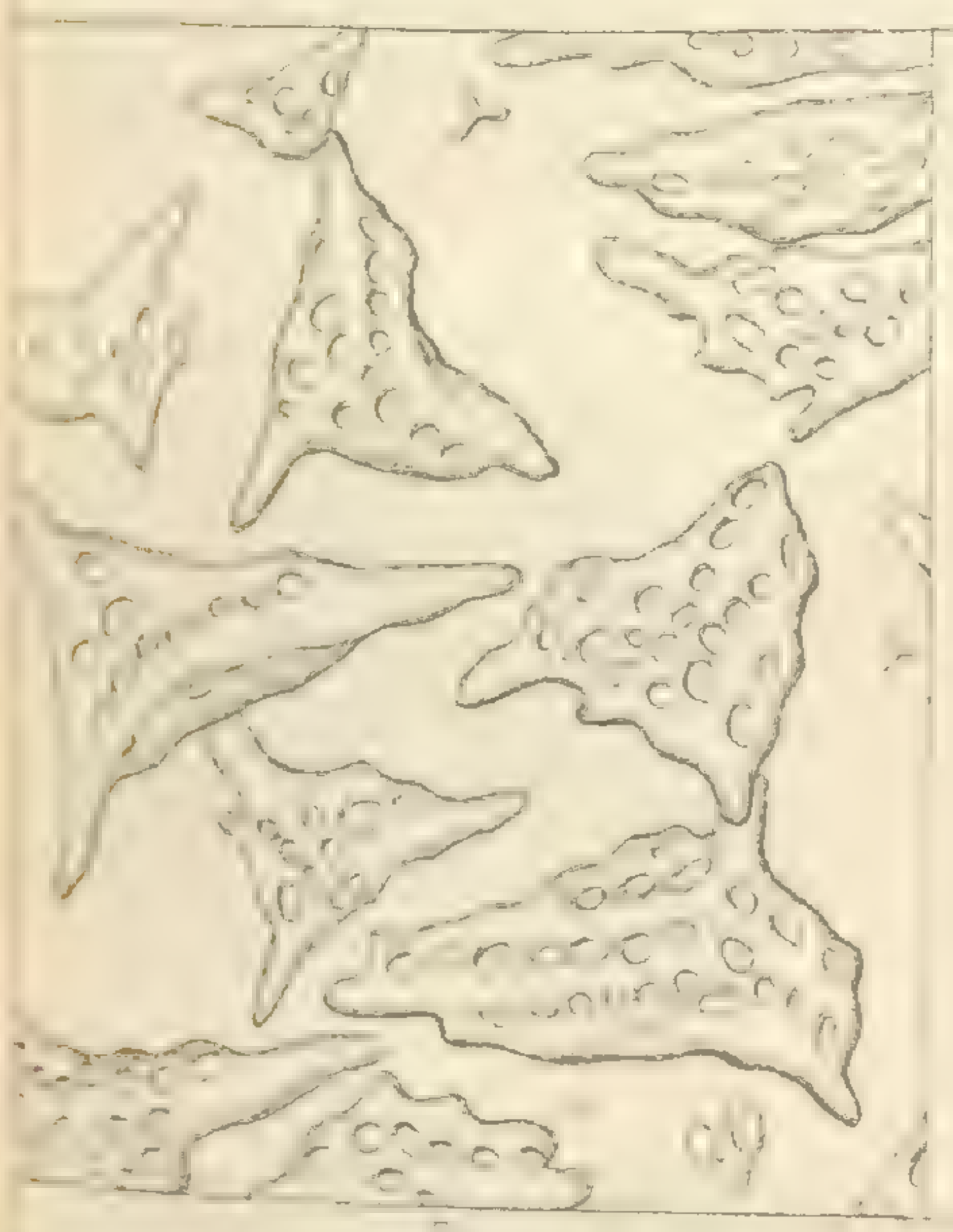

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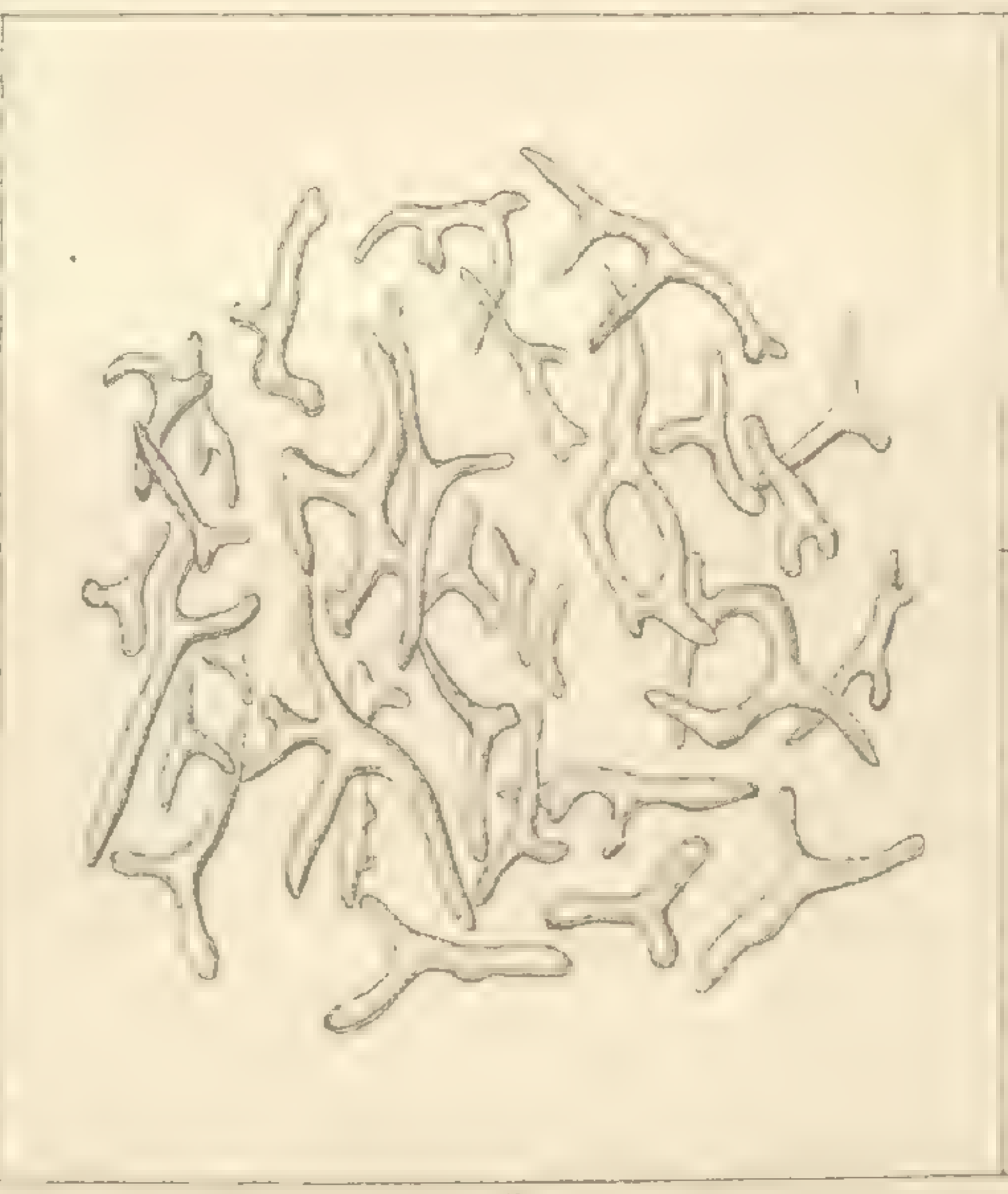

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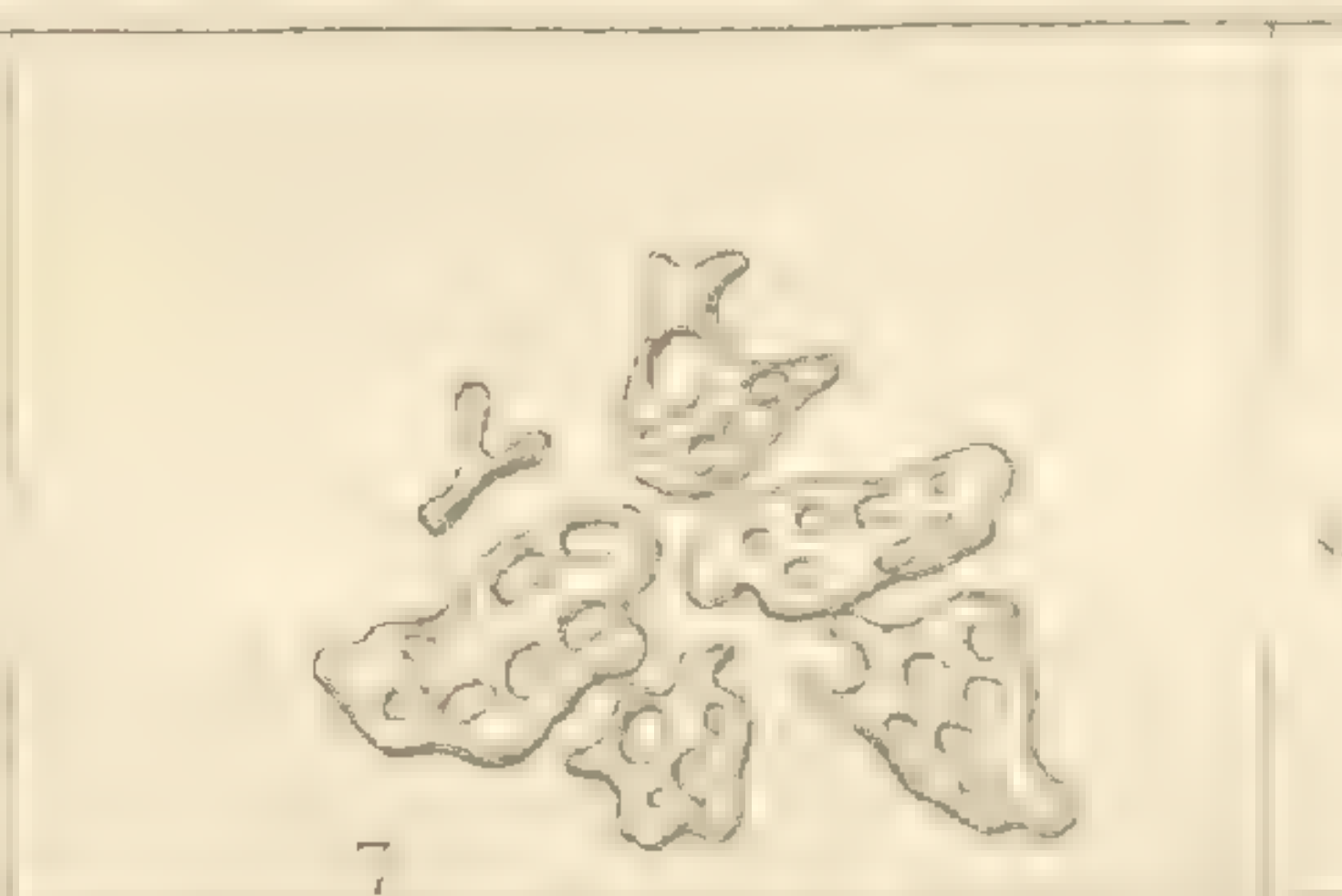

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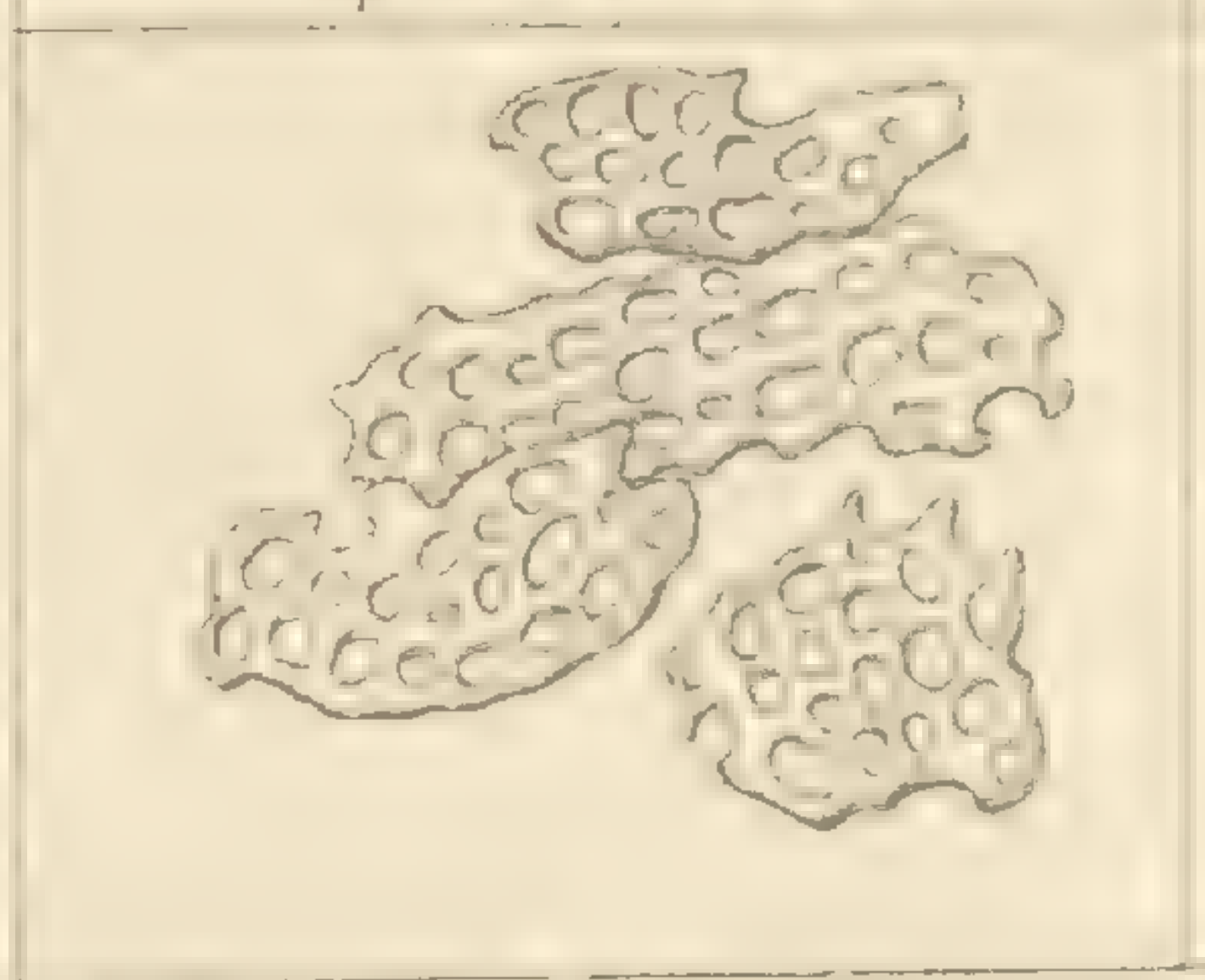

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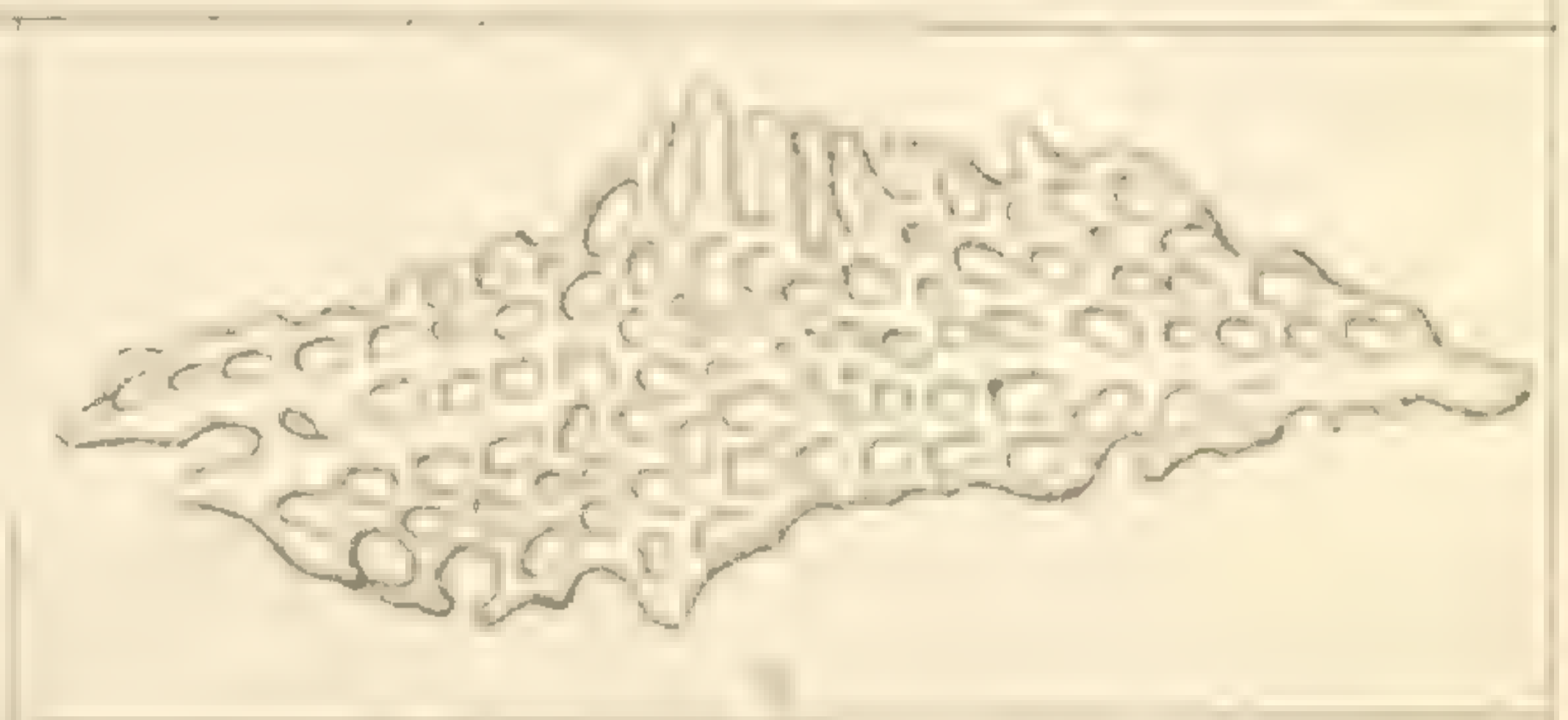

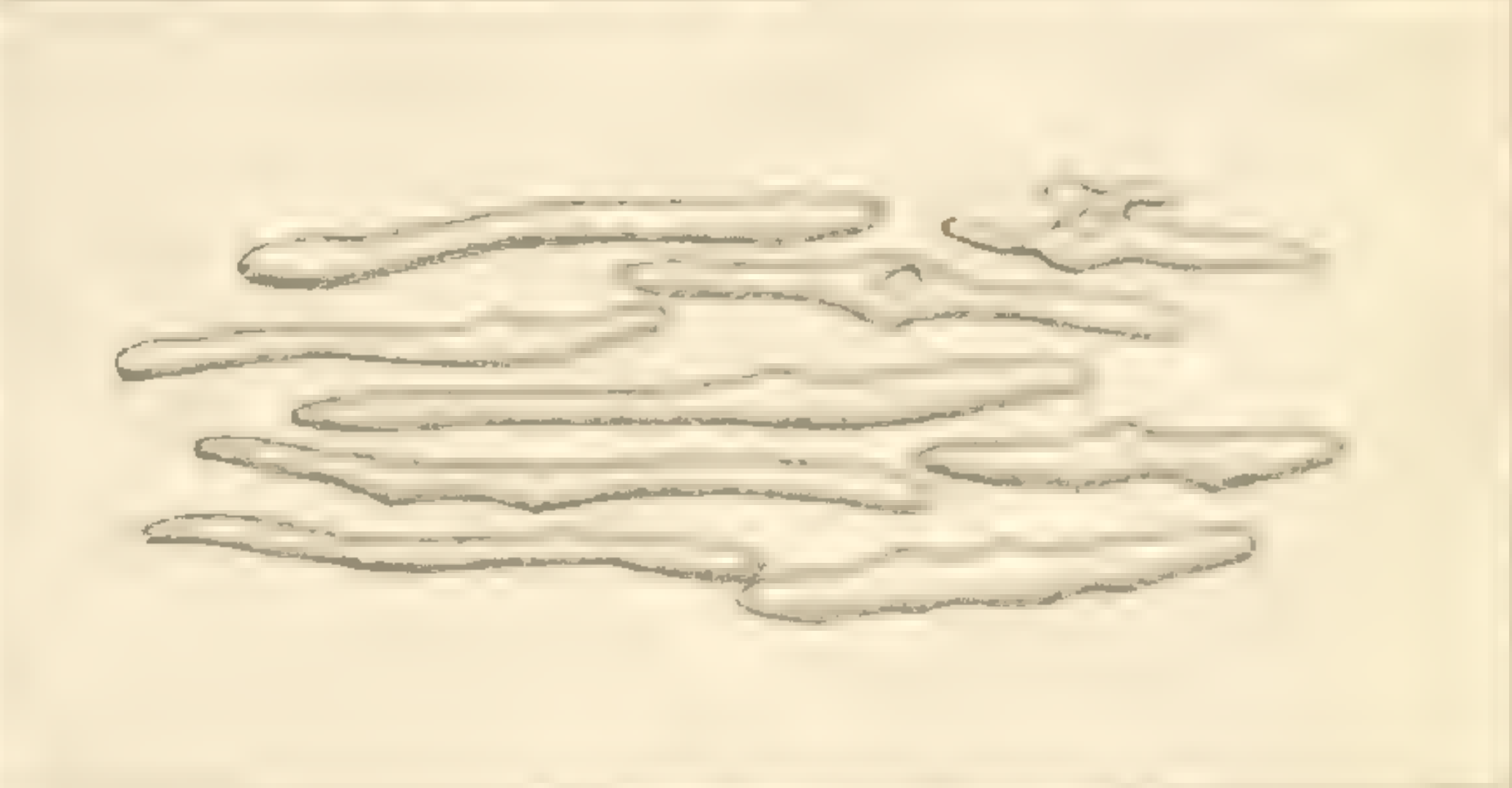

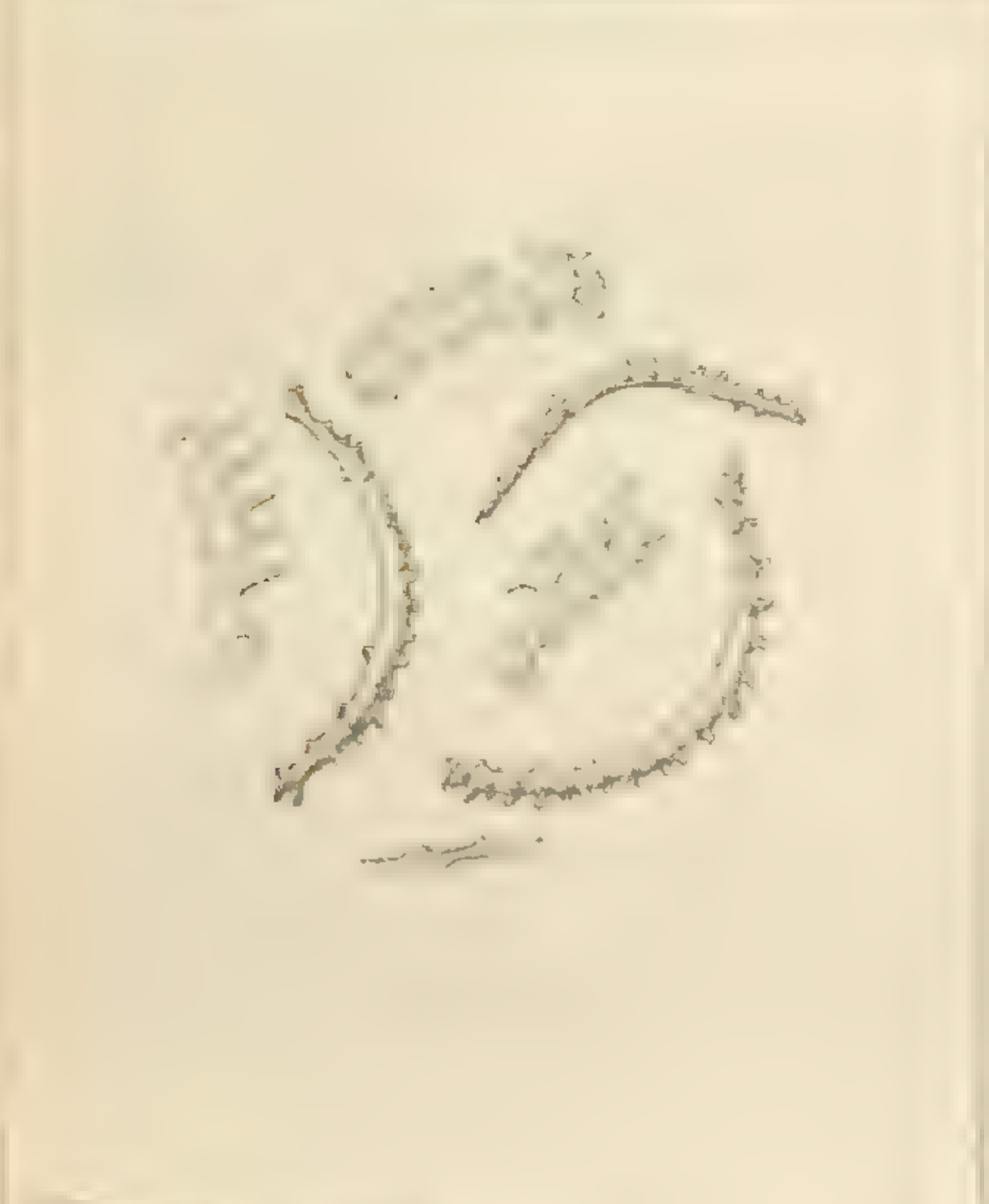

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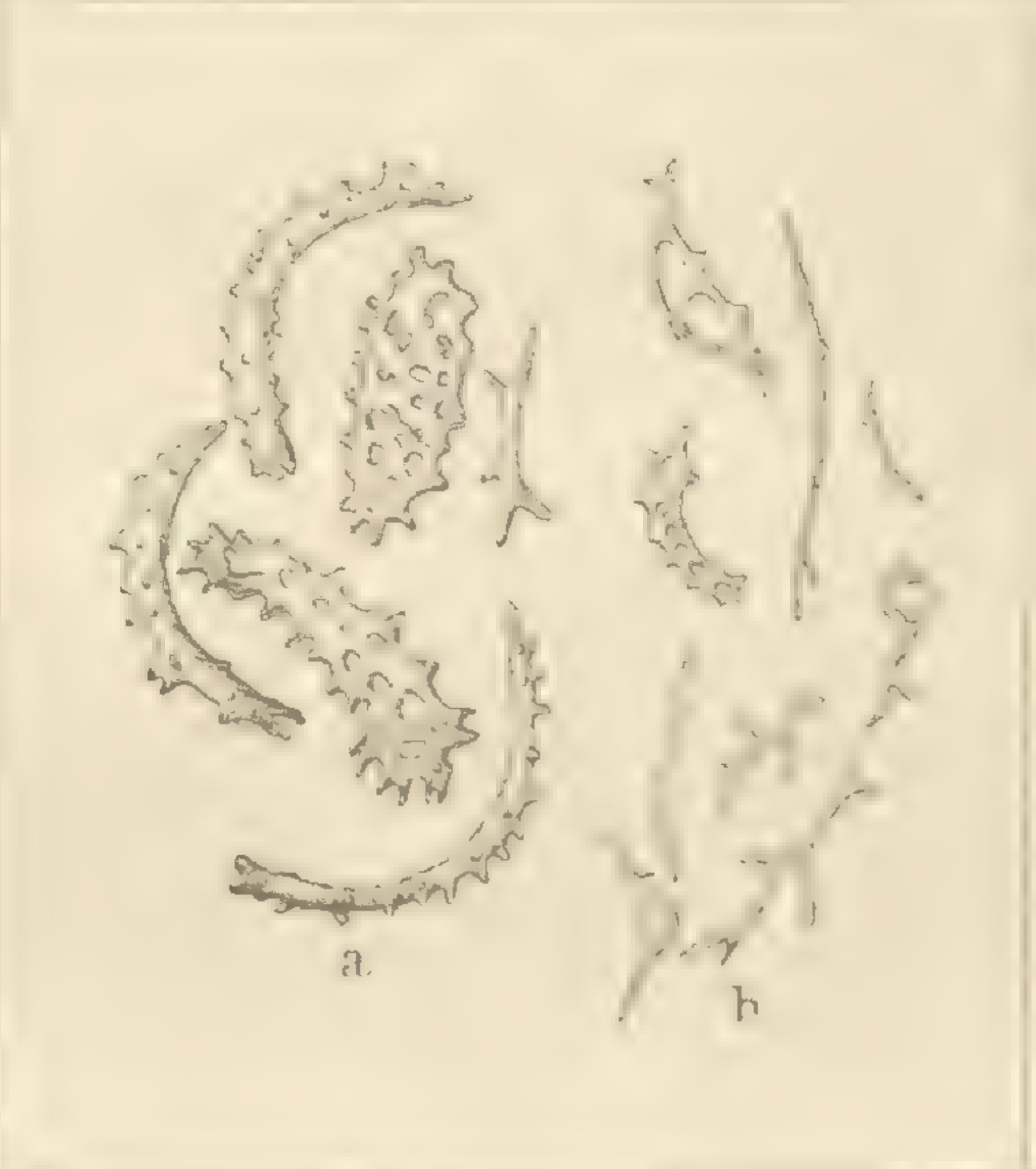

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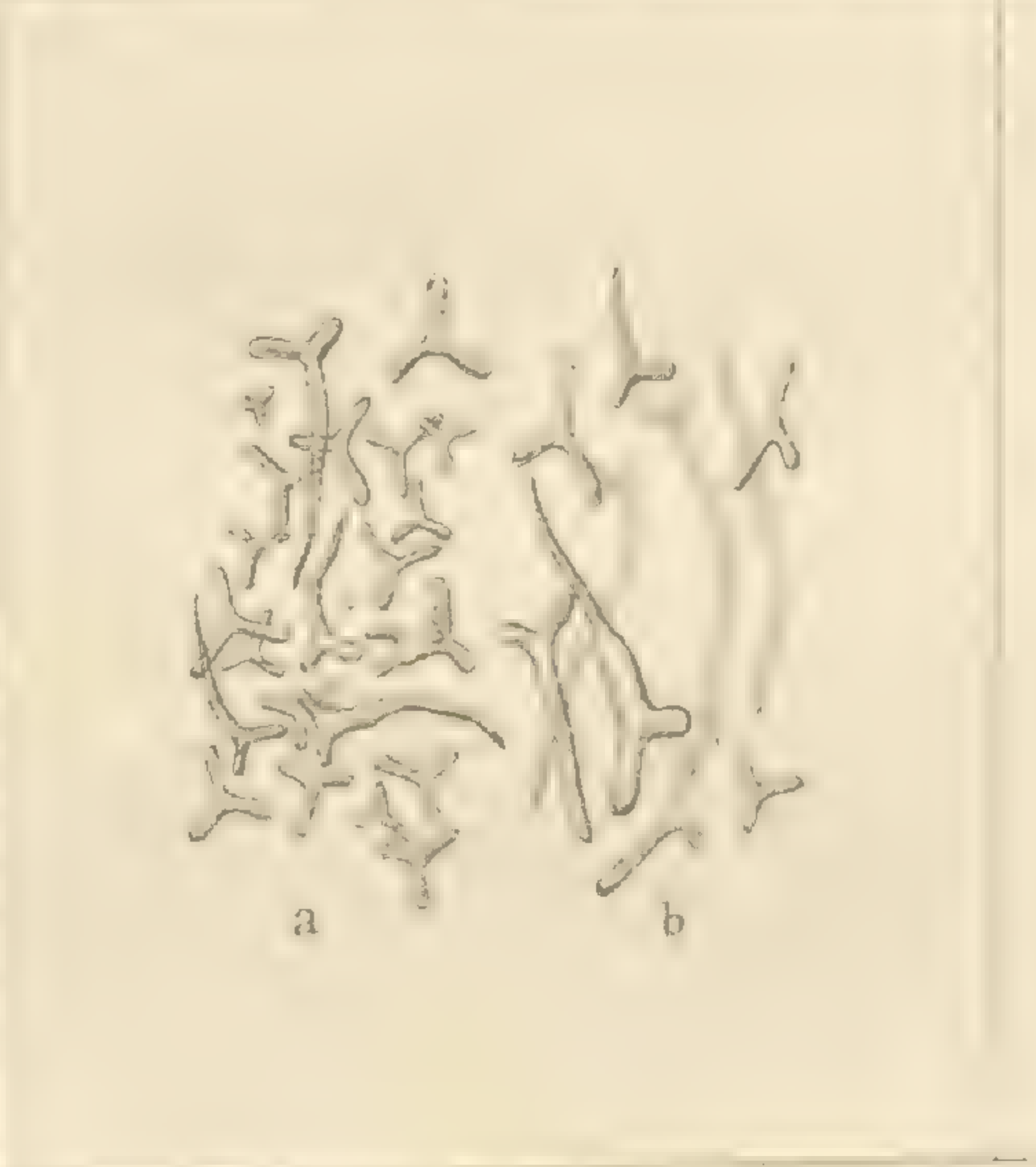

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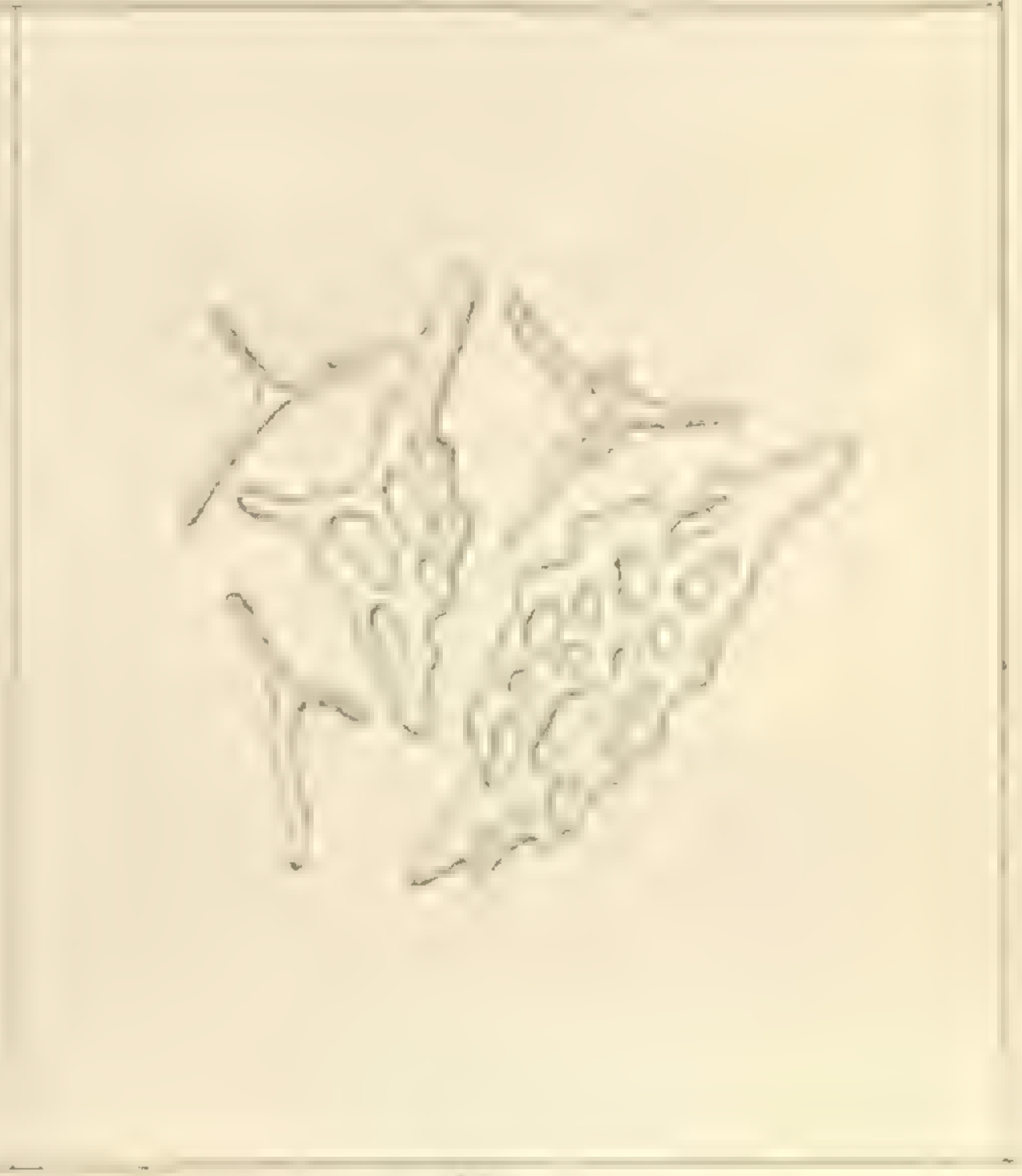

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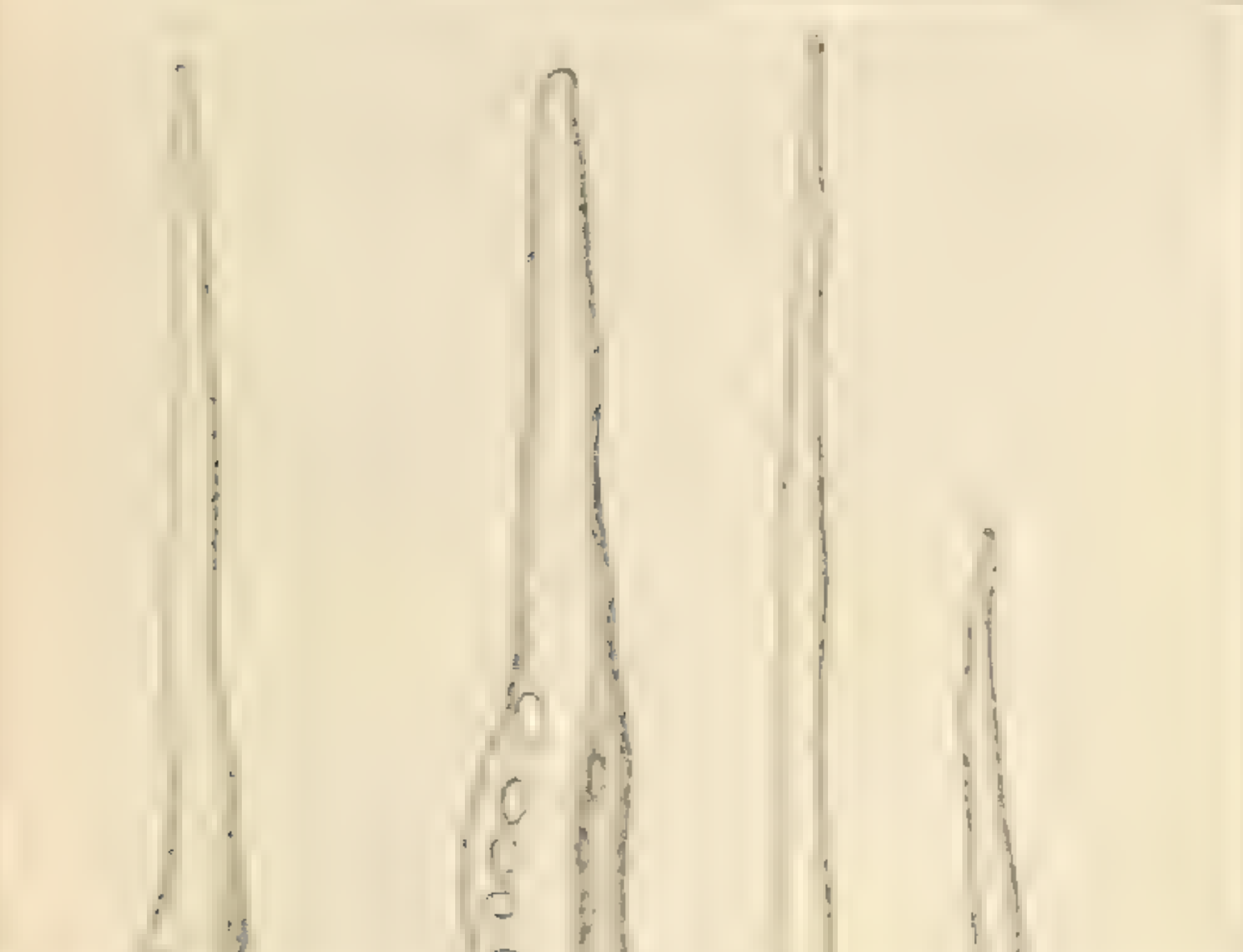

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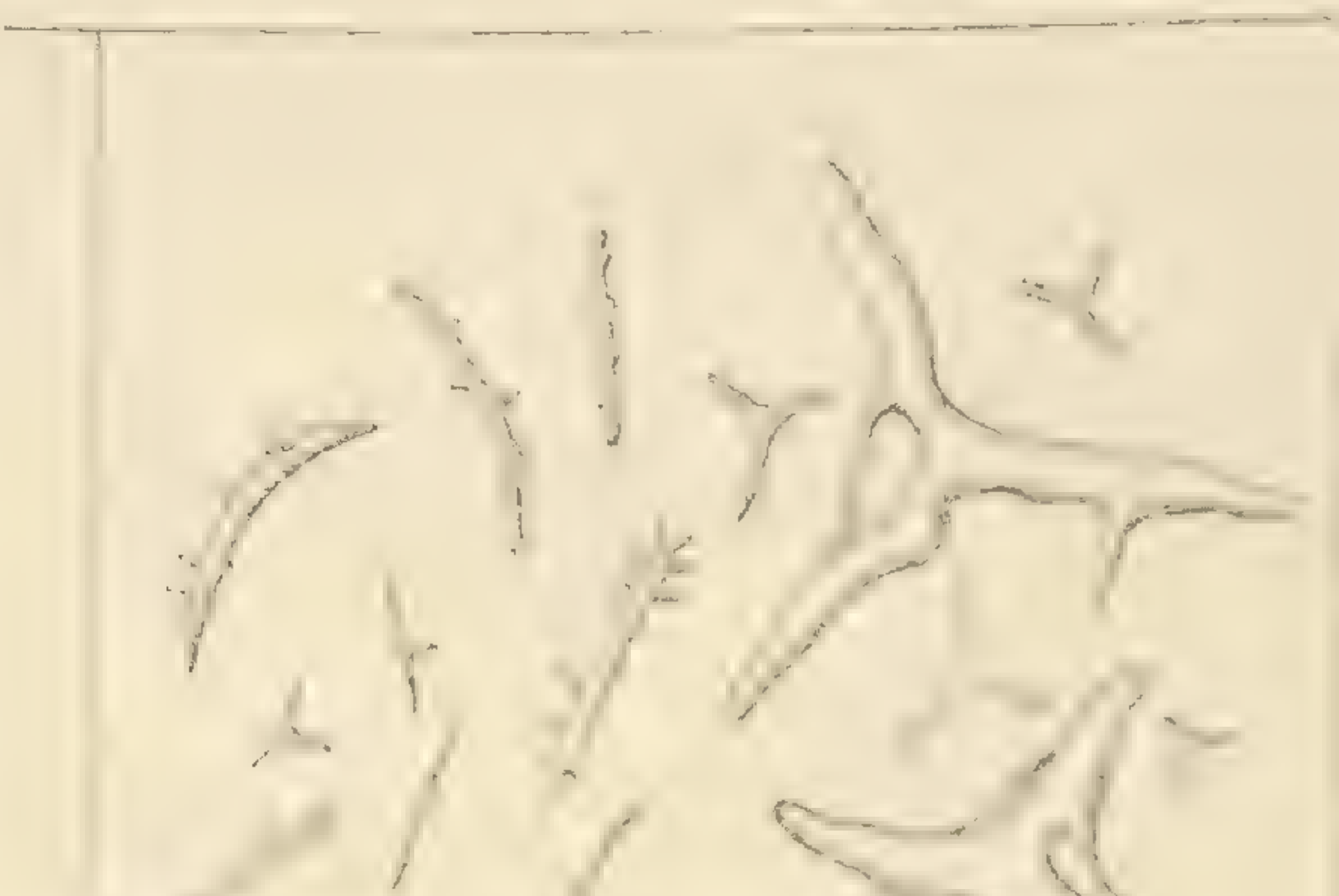

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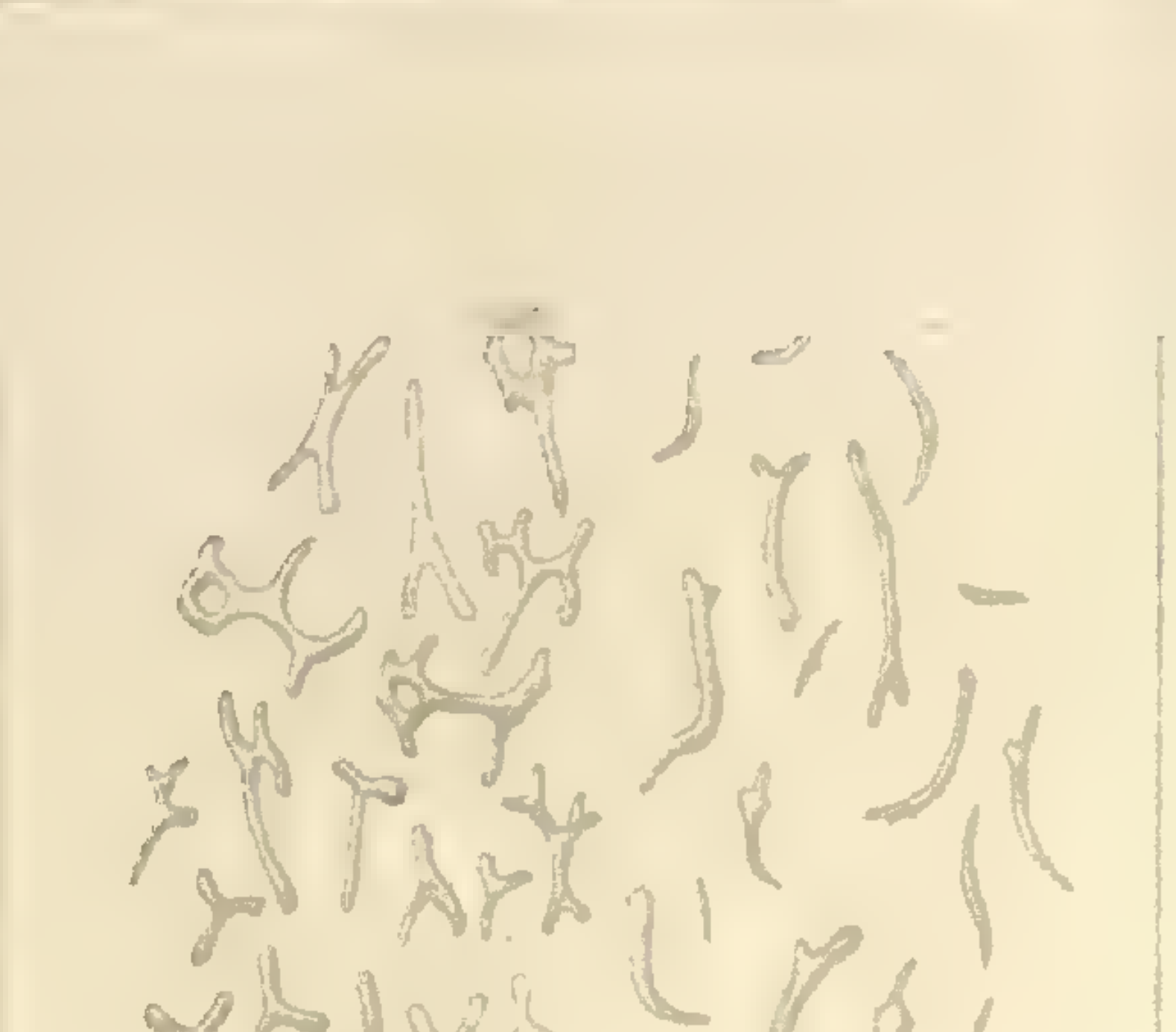

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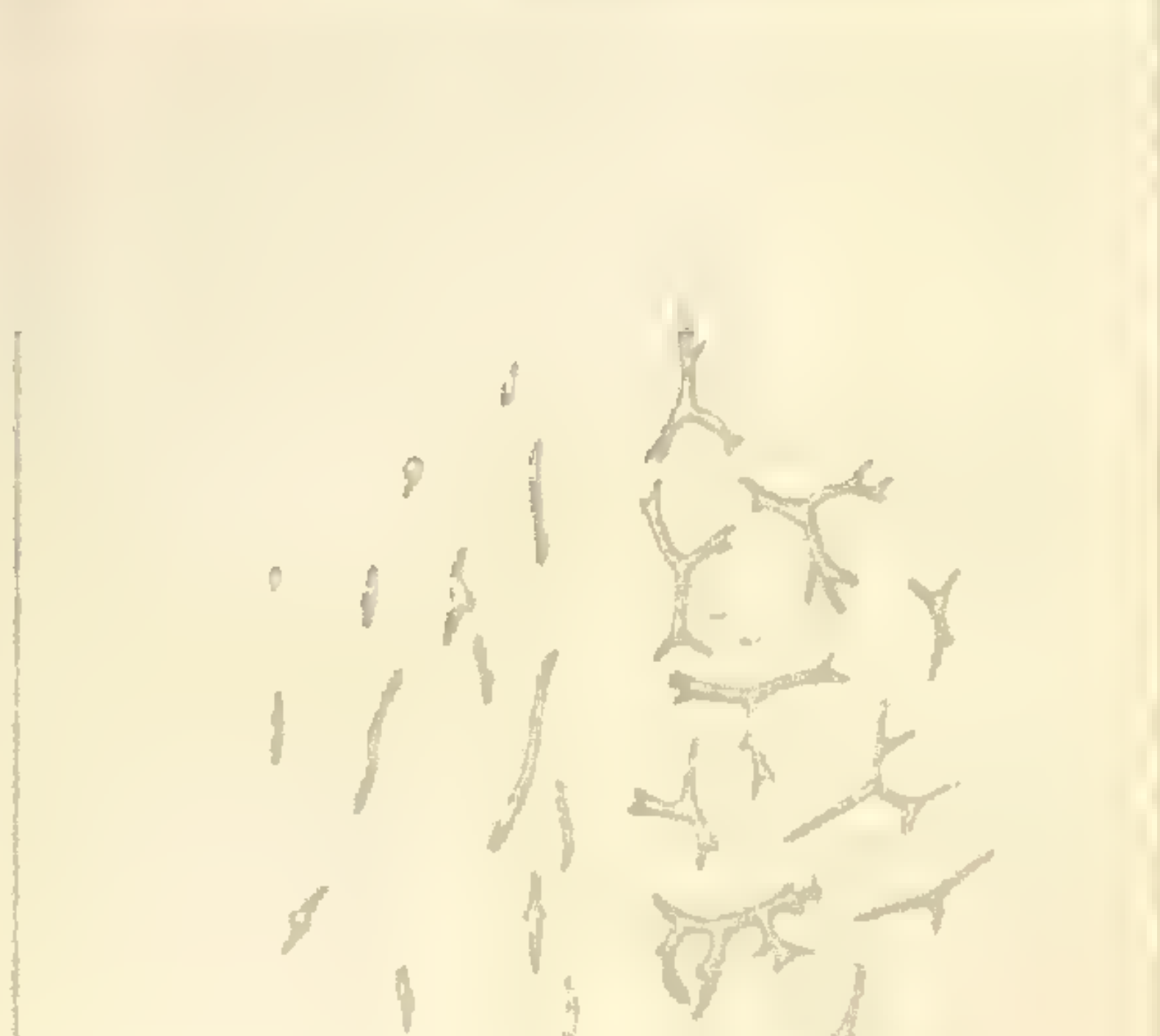

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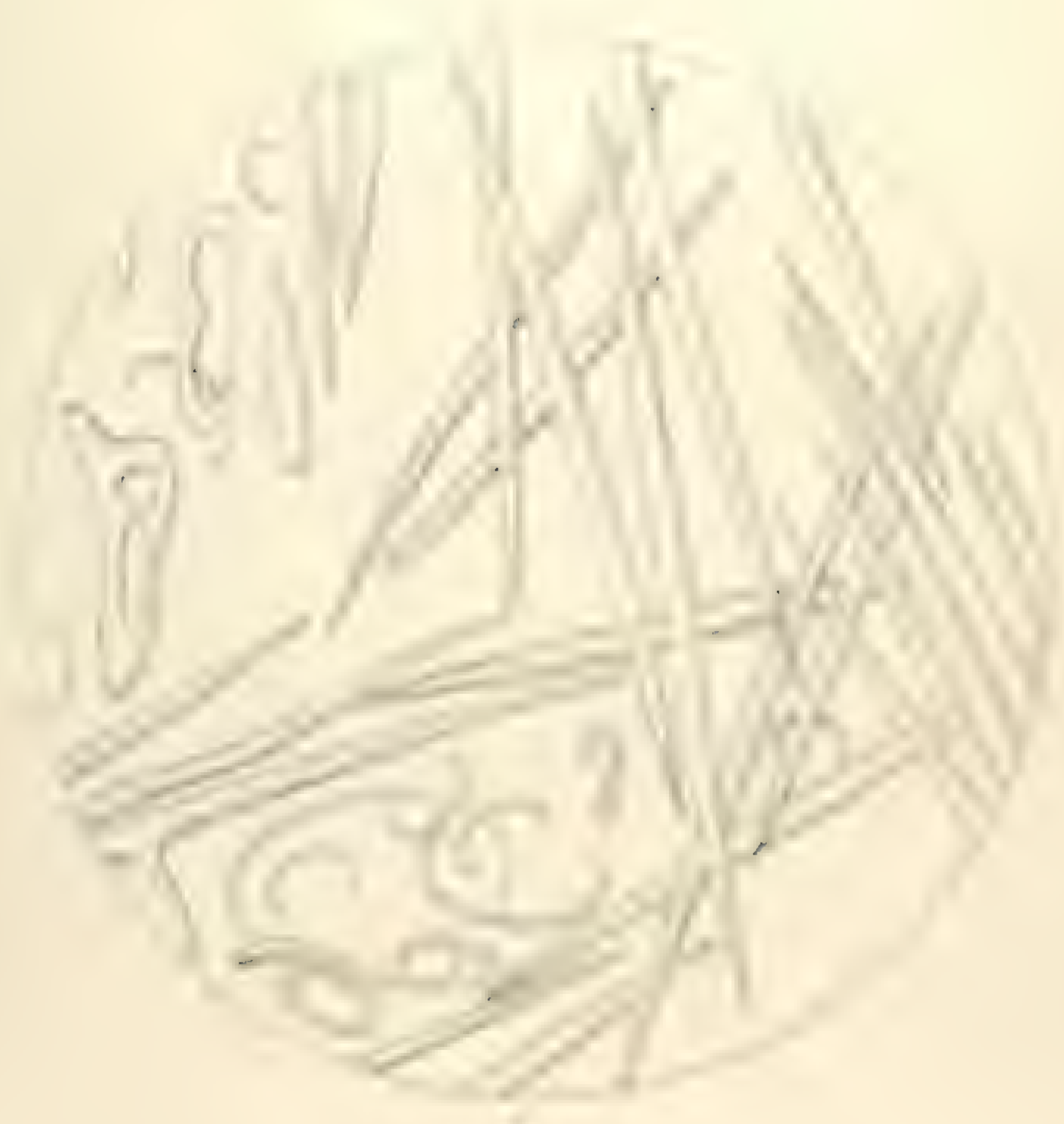

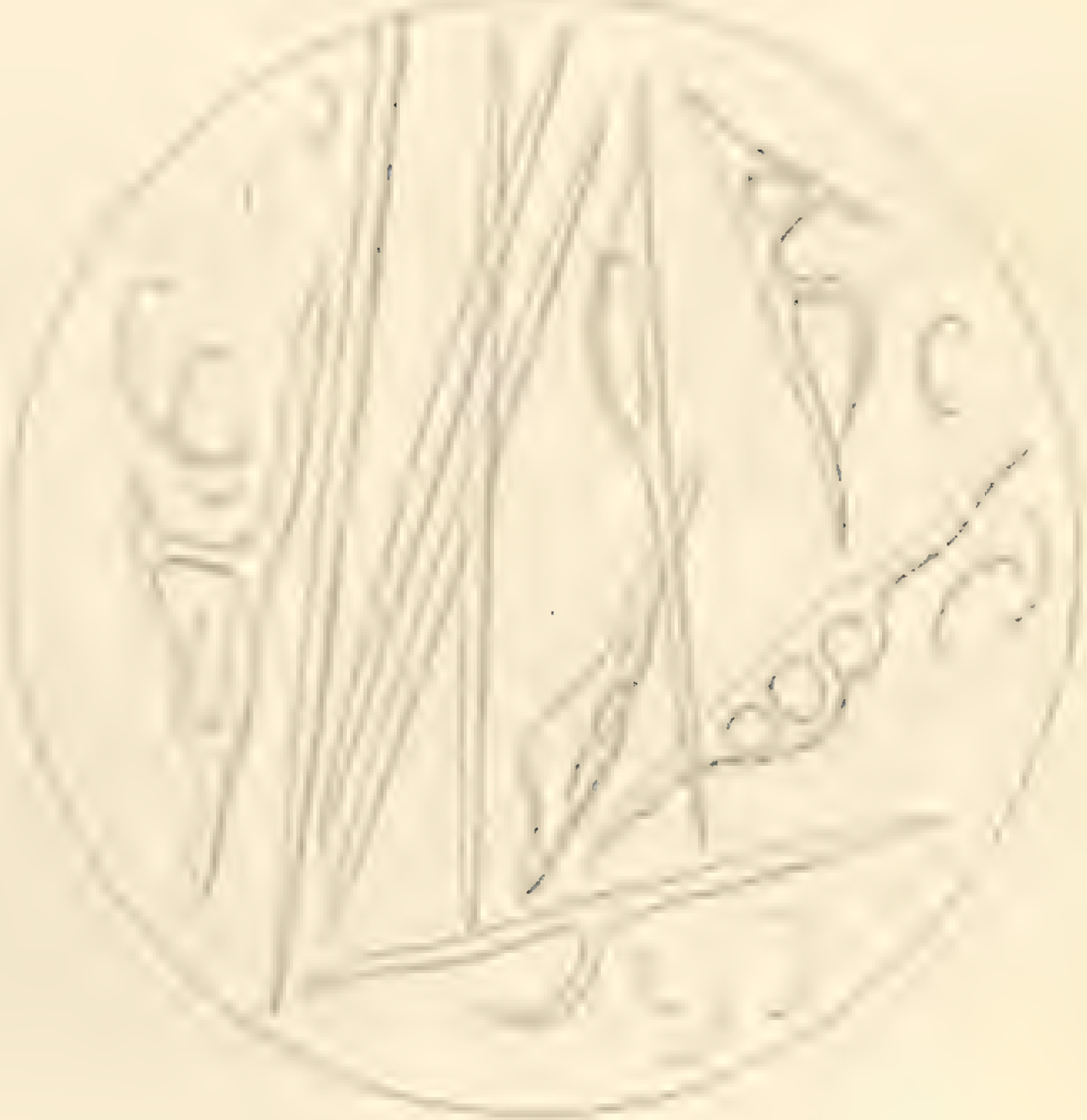

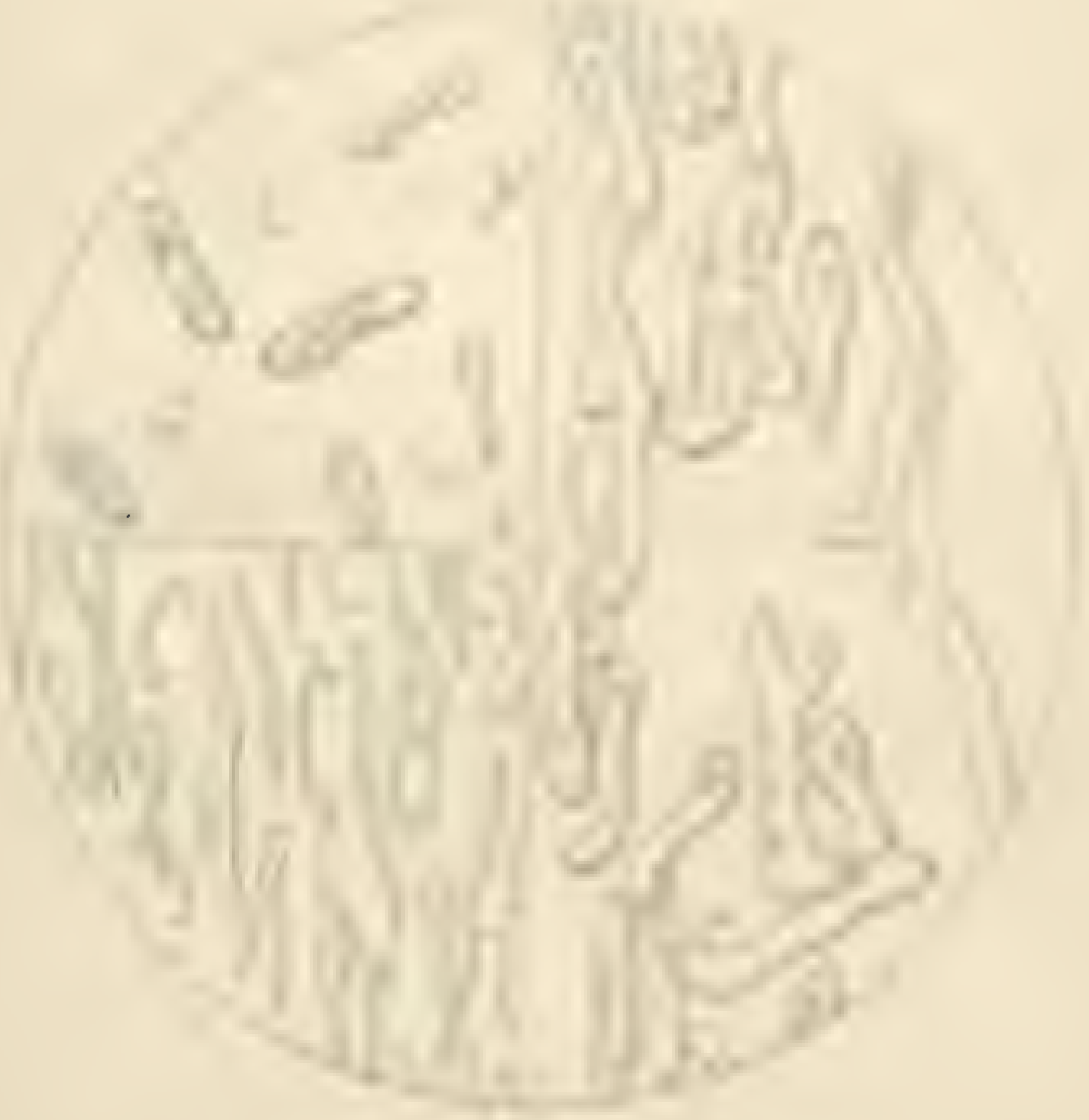

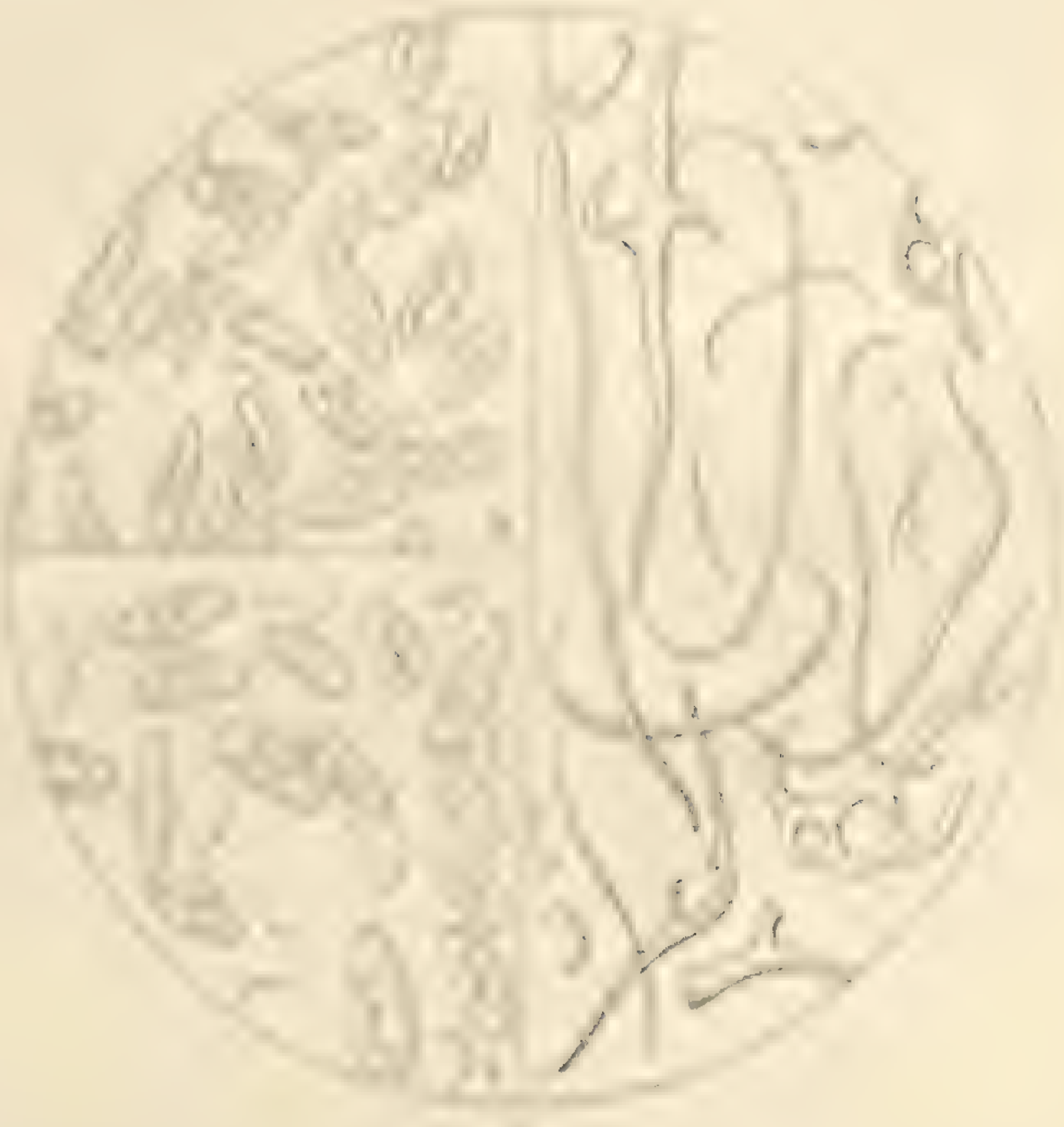

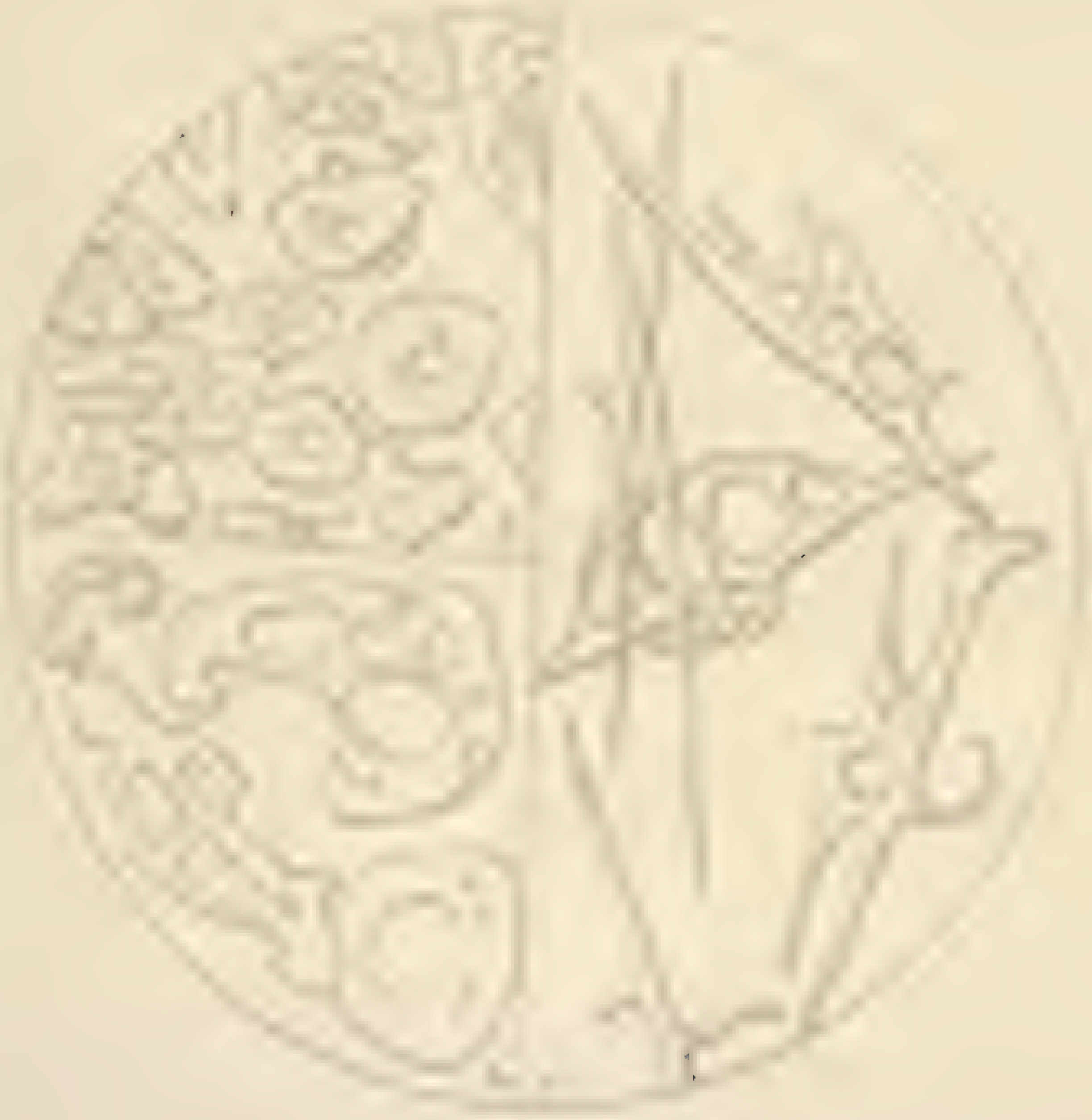

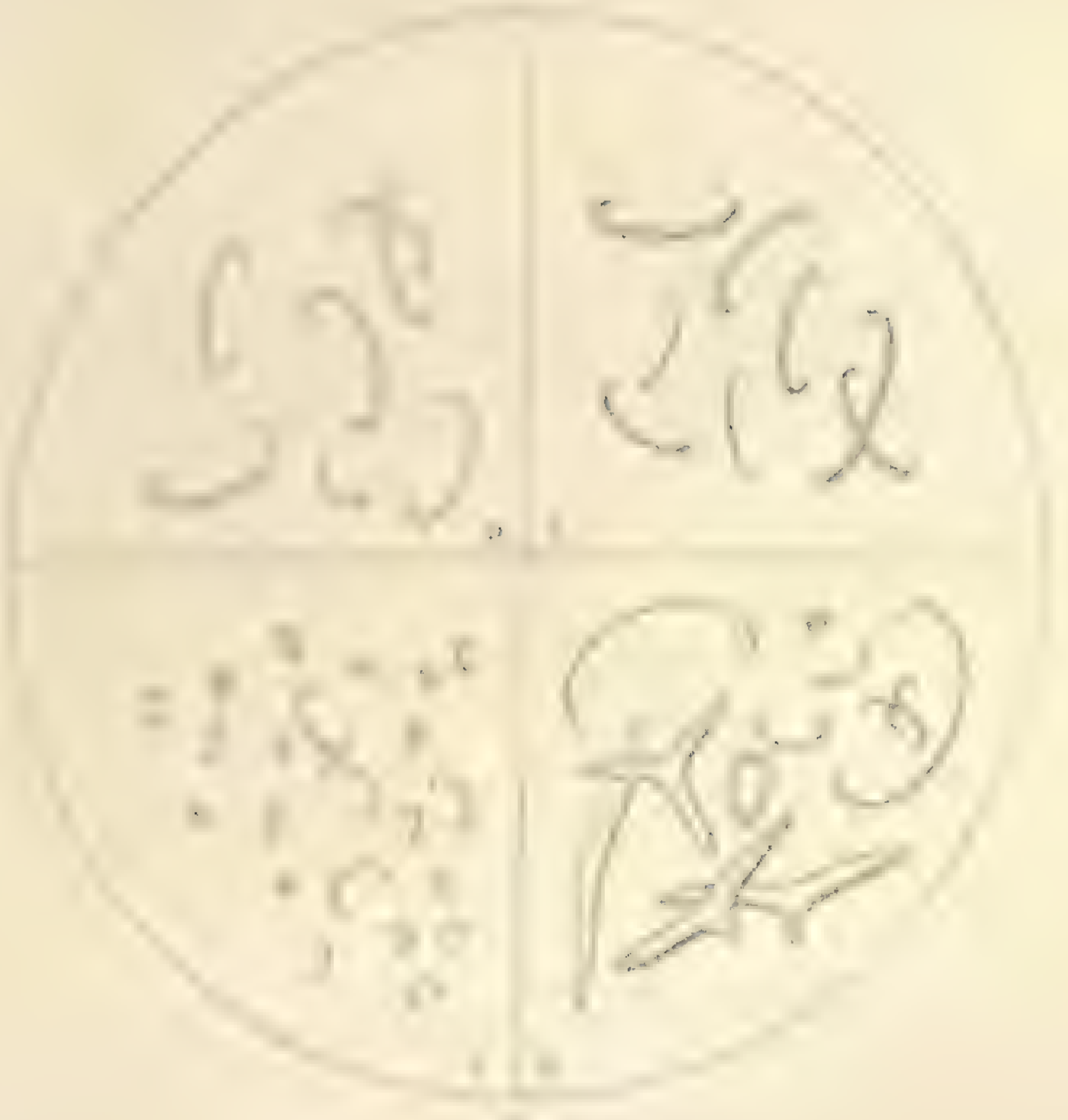

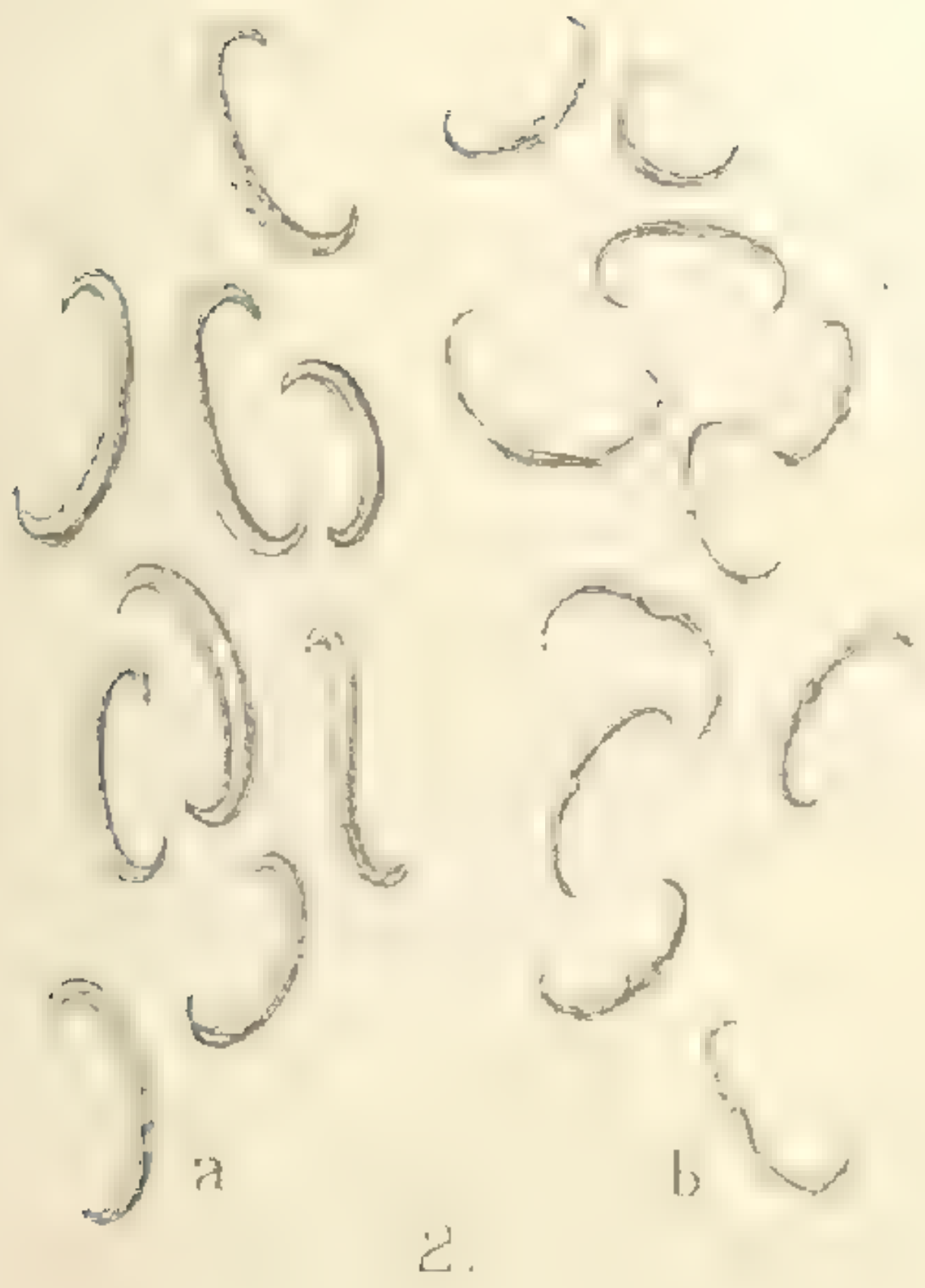

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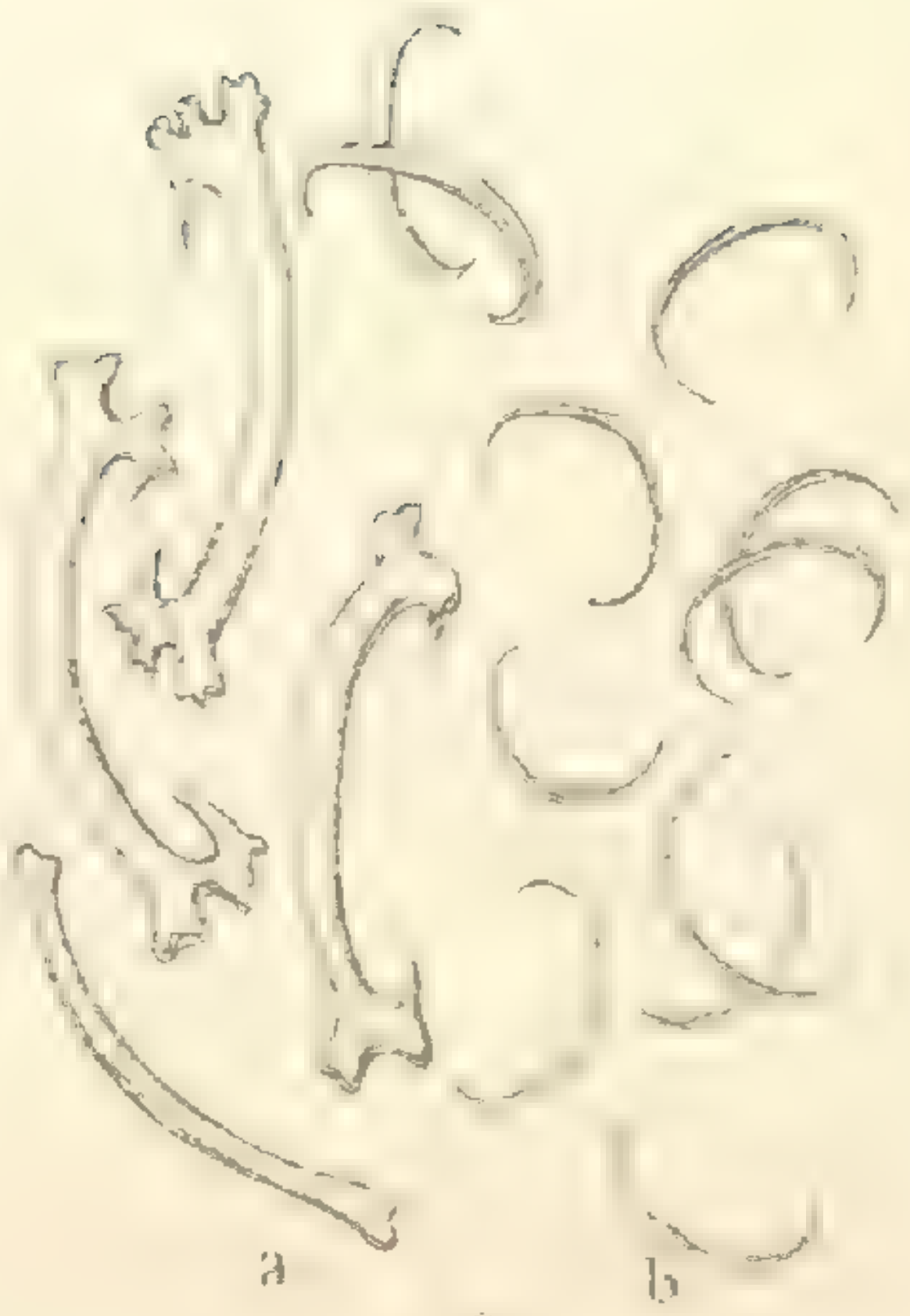

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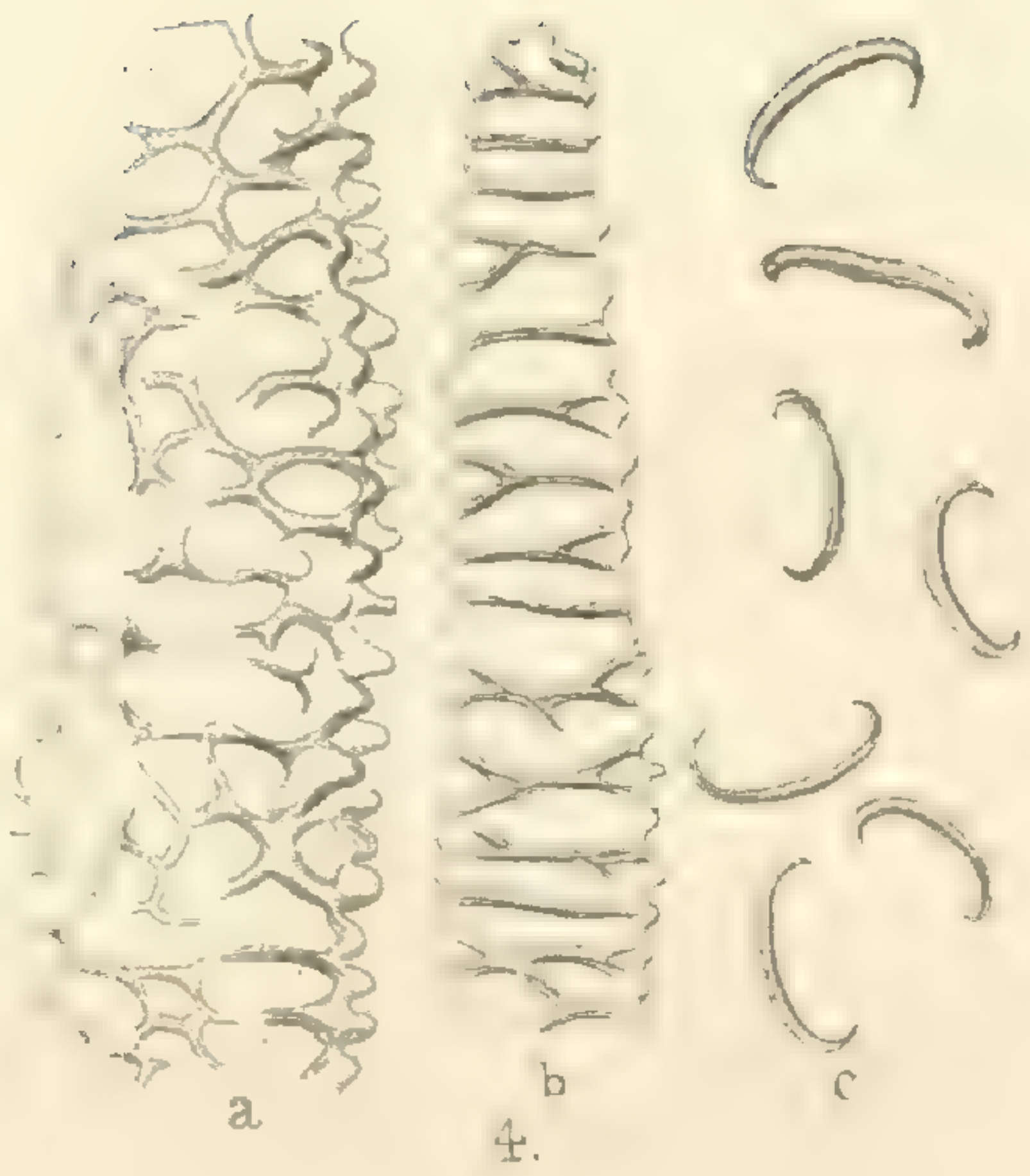

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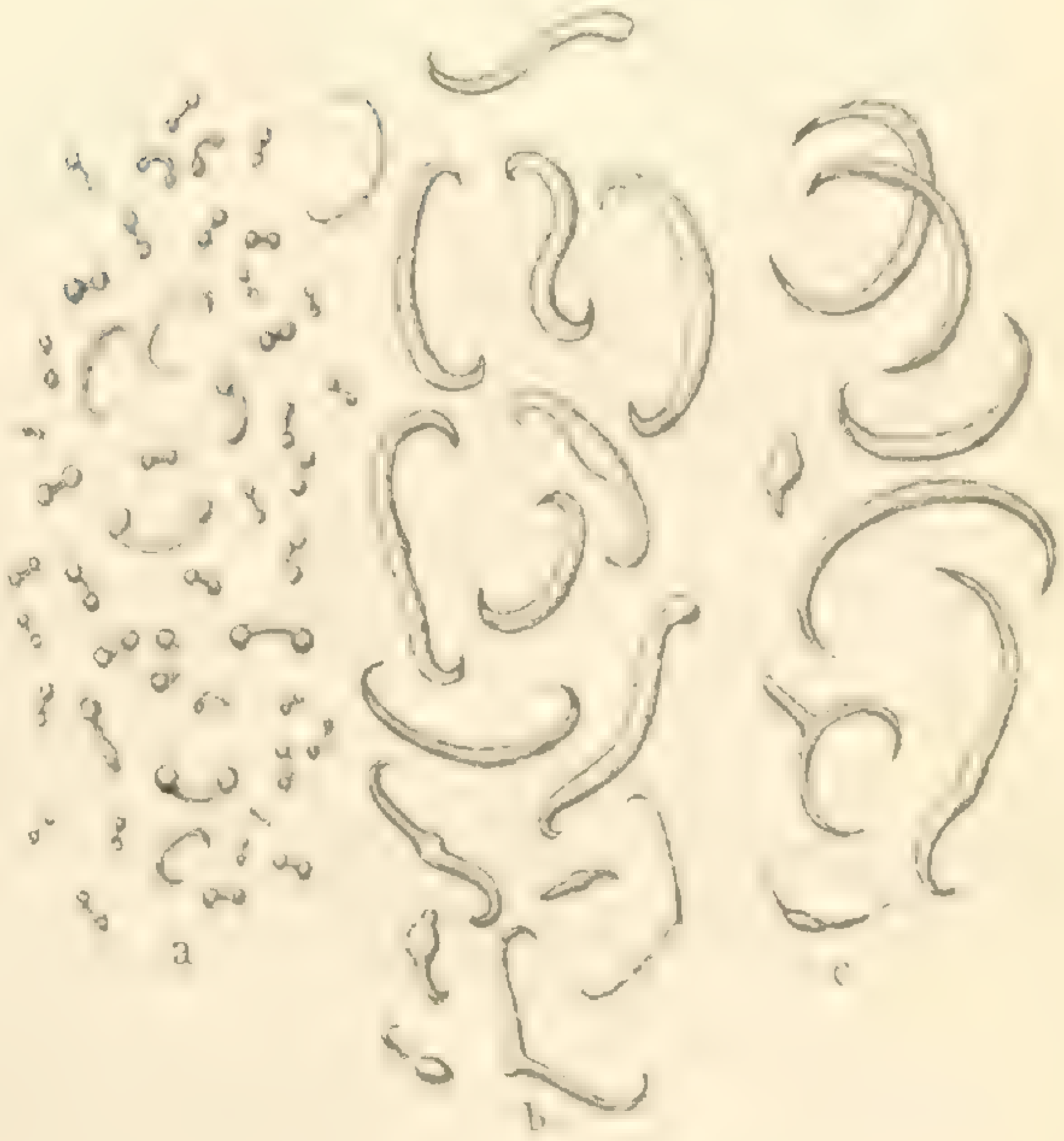

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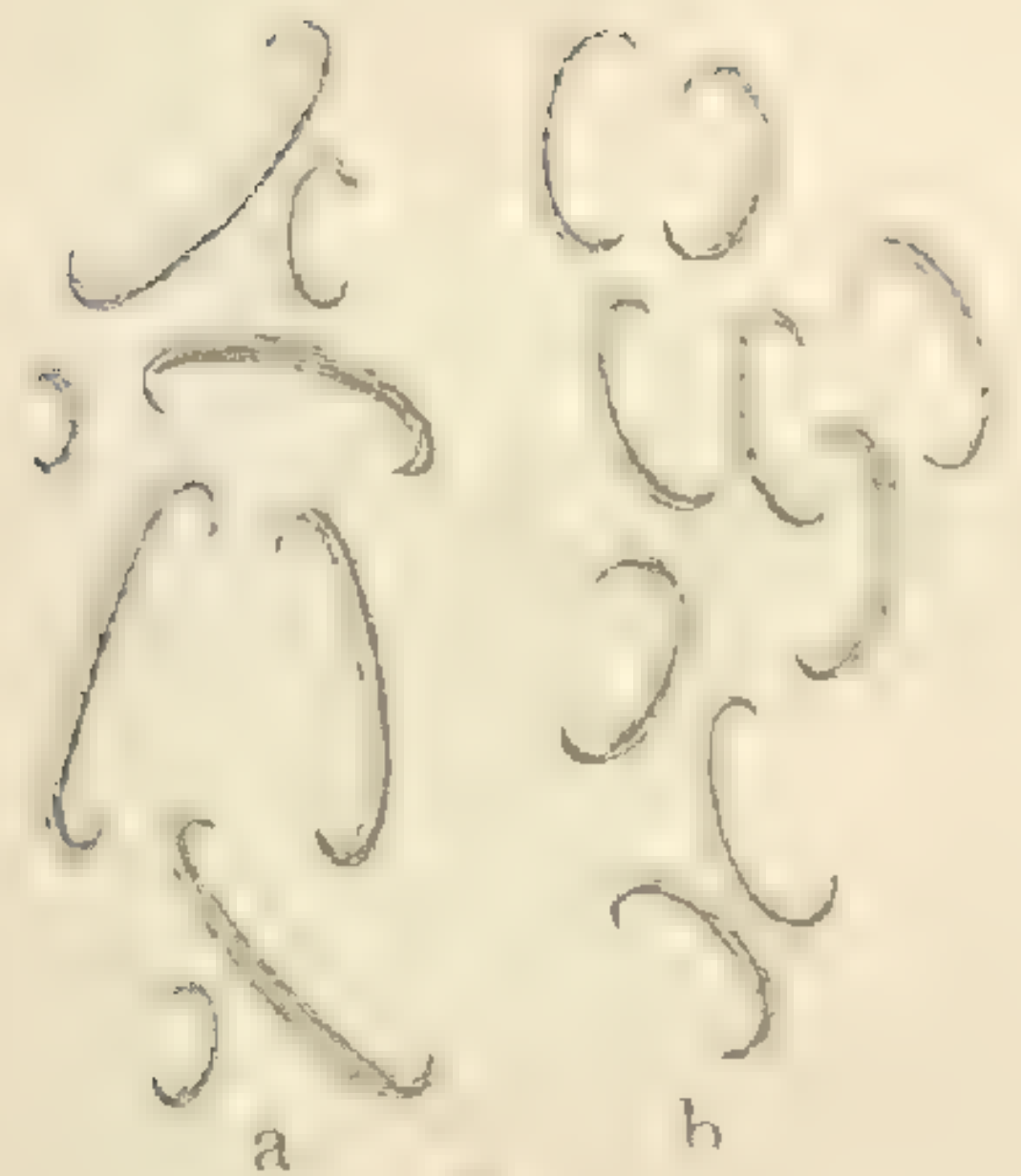

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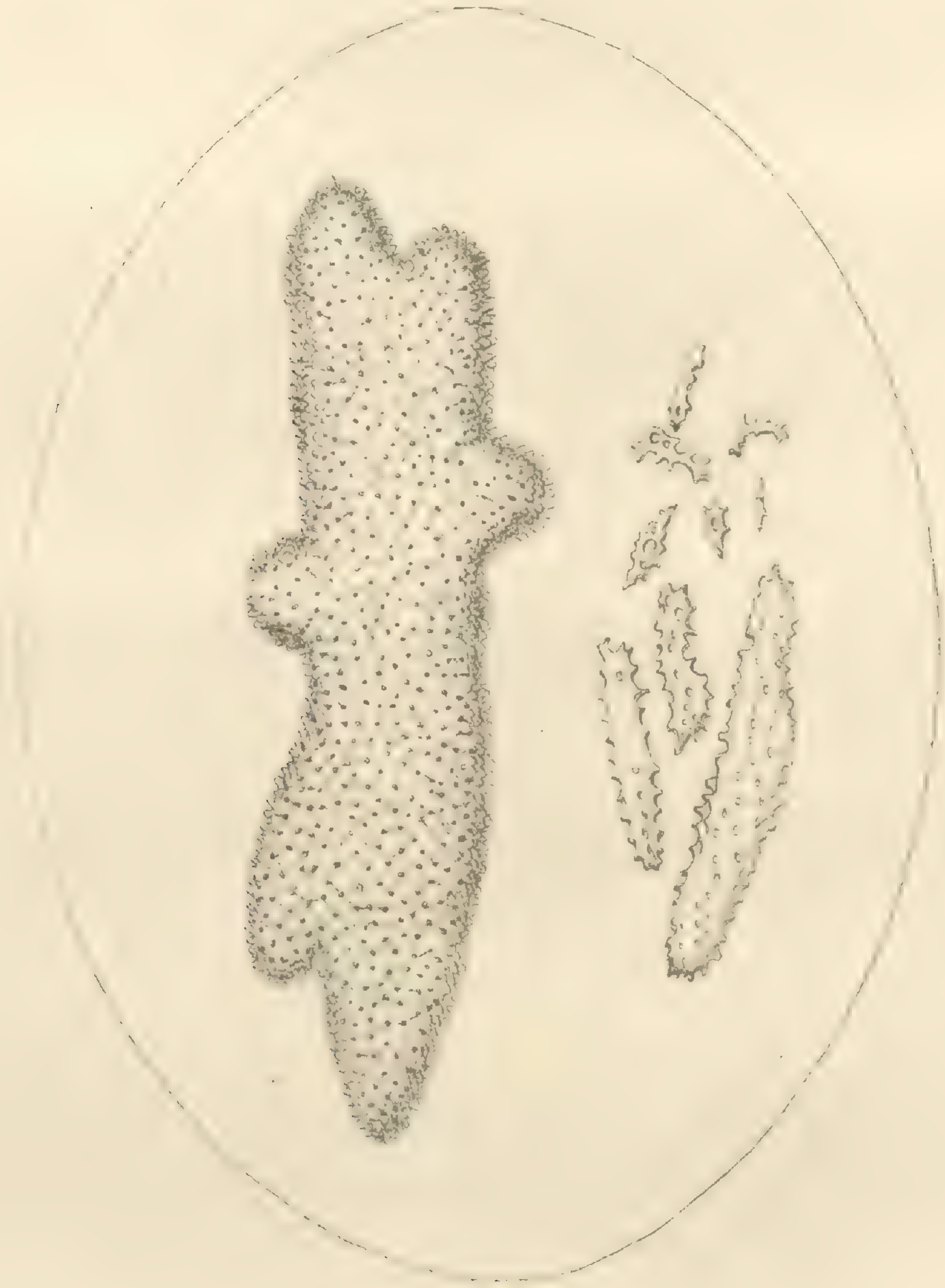

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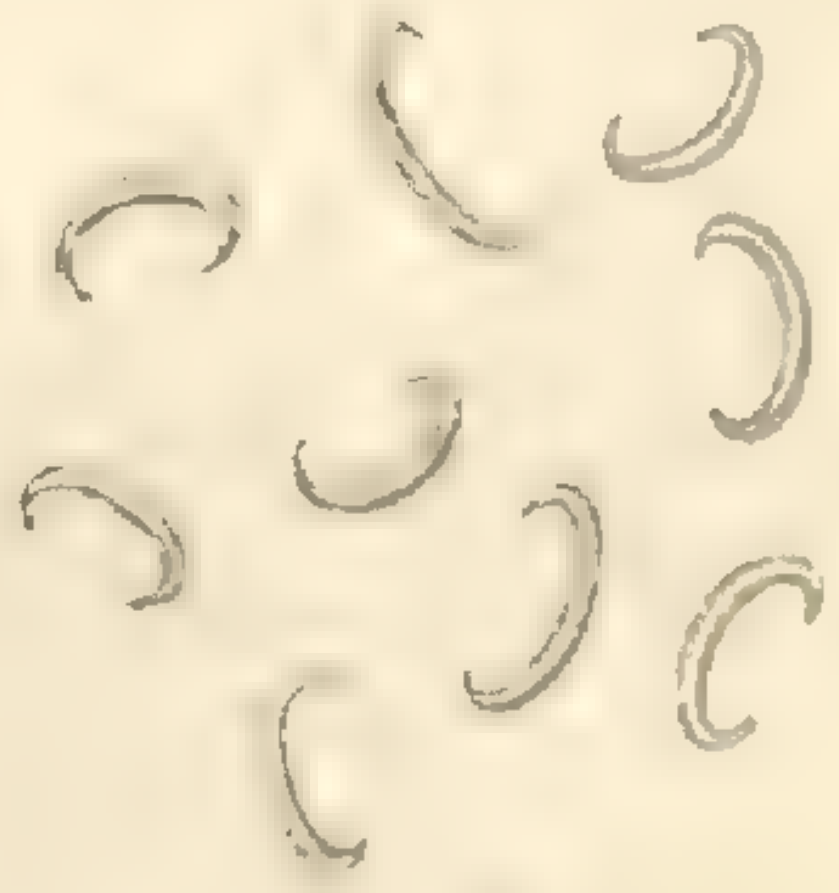

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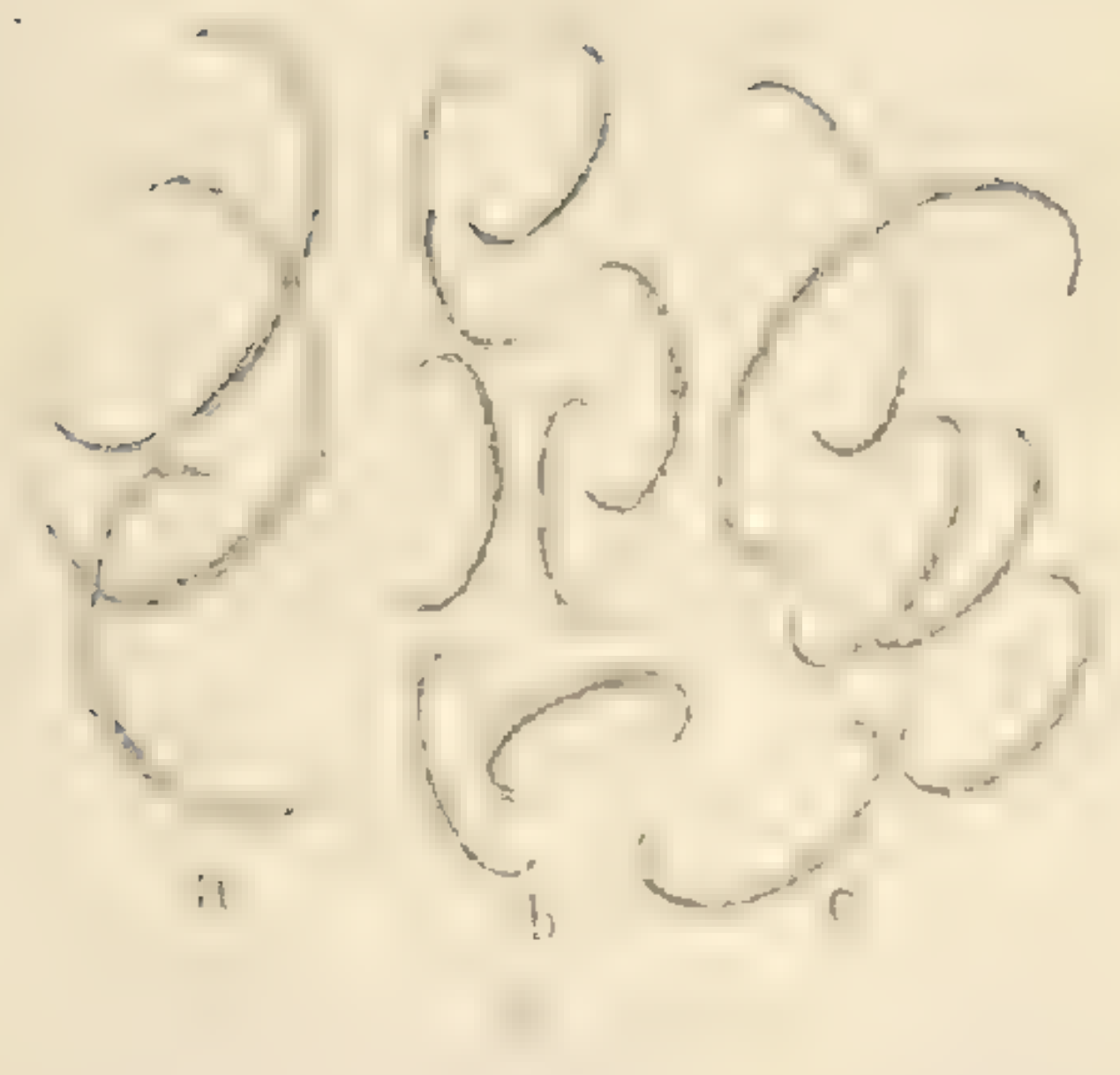

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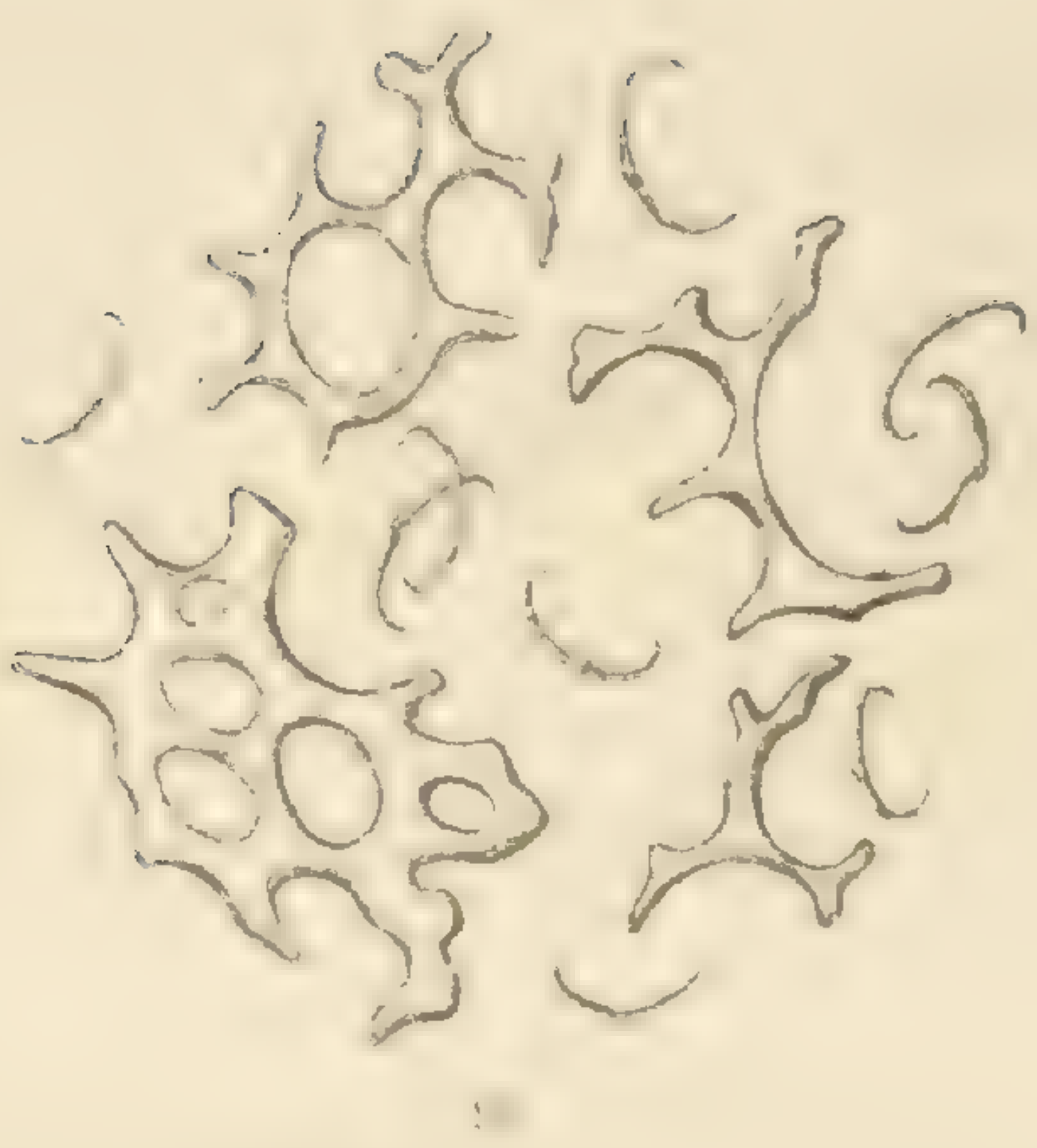

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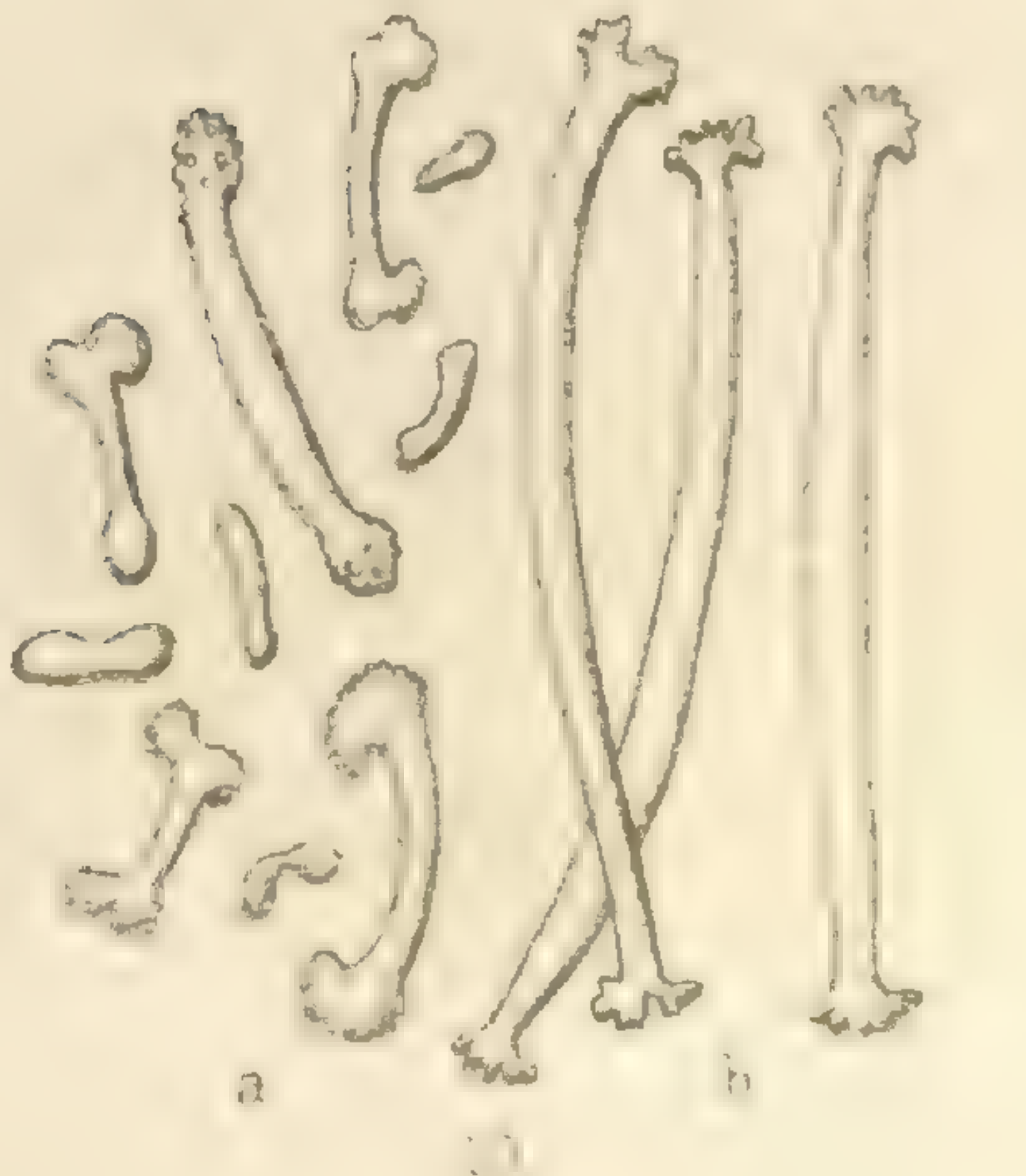

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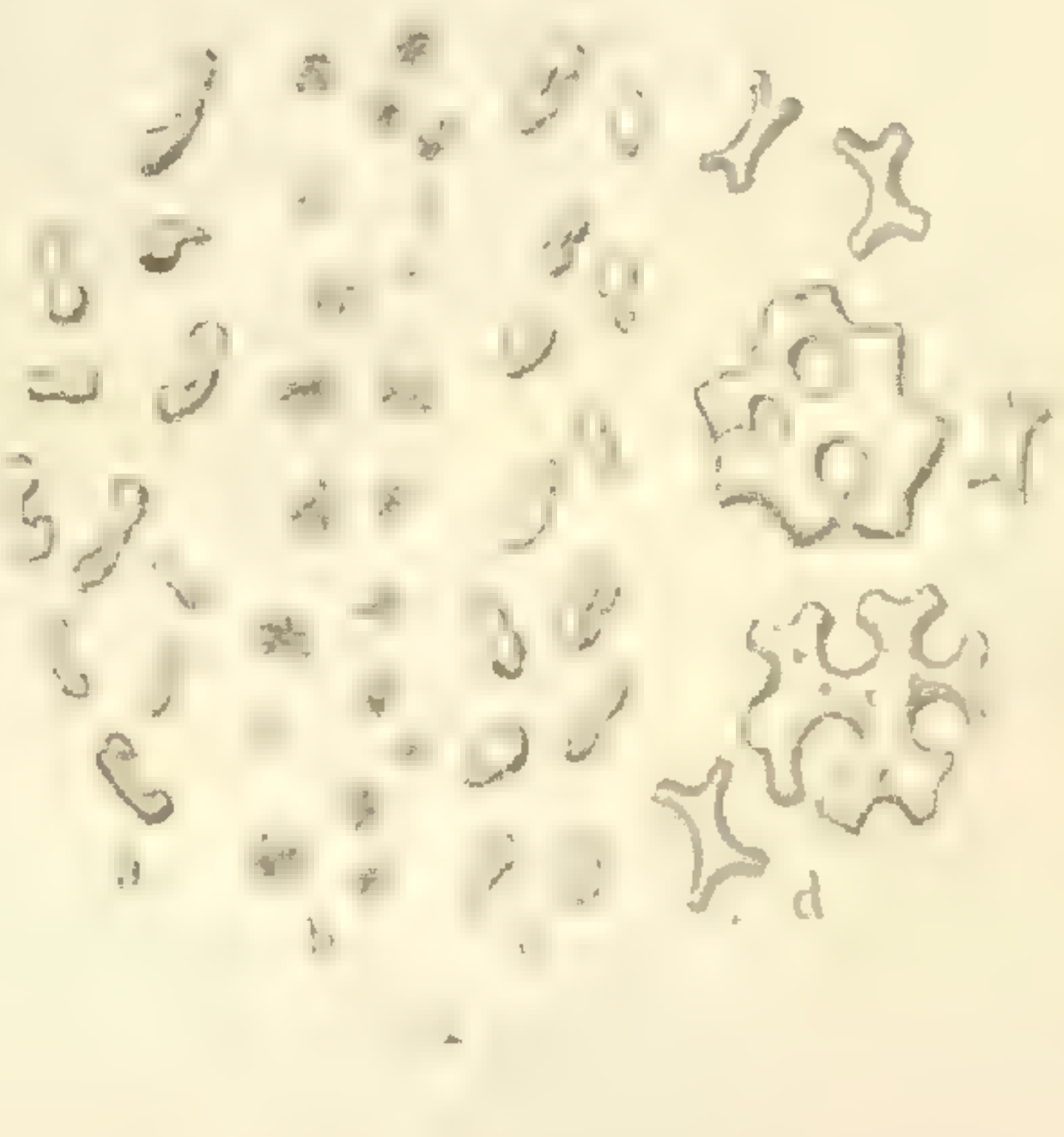

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Charles Stewart del.

XIII. *On some New British* Polynoïna. *By* E. RAY LANKESTER, *Esq.* *Communicated by* J. G. JEFFREYS, *Esq., F.L.S.*

(Plate LI.)

Read January 18th, 1866.

THE species described in the following pages were collected by me while in Guernsey, last summer, with my friend Mr. Gwyn Jeffreys, dredging under the grant of the British Association. I have had very great difficulty in studying the Annelida obtained thence, as every systematic work on these animals with which I am acquainted, in either French or English, is most unsatisfactory and imperfect. Prof. Malmgren's work on the North-Sea Annelida, now in course of publication, has given me much valuable assistance, as also Prof. Kinberg's work in the 'Voyage of the Eugenie.' Both of these are written in the Swedish language; but the descriptions and much valuable matter are given in Latin. I have endeavoured, as far as possible, to take Prof. Malmgren's descriptions of species as my model, and have, I hope, succeeded in making my descriptions uniform with his. I have, however, introduced one or two alterations in the nomenclature, mainly as suggested by Prof. Huxley in his Lectures on General Natural History. Thus all the somites in front of the mouth are called the "*prostomium*," and the *tentaculum* is called the *prostomial tentacle*. The somite round the mouth is called the *peristomium*, and its appendages, usually known as *tentacular cirri*, are called *peristomial cirri*. Each foot is called a *parapodium*, and divided into a *notopodium* and a *neuropodium*, corresponding to the "rame dorsale" and "rame ventrale" of Audouin and Milne-Edwards. The segment beyond the anus is denominated "*pygidium*." All the somites provided with feet are called *truncal somites*, and form the *trunk* (segmenta pedibus instructa), while the prostomium and peristomium form the "*head*" (pars cephalica). The number of somites constituting the prostomium is a subject still requiring investigation, but does not come within the scope of the present paper. The remarkable and very varying histiological characters of the "elytra" in the Polynoïna are also exceedingly interesting, and might be made to furnish generic characters as readily as the form of the setæ. Nearly all the Annelida now to be described were obtained under rocks and stones at low-water mark.

HARMOTHOË (Kinberg).

Body oblong. Antennæ attached under the base of the prostomial tentacle, which occupies a frontal incision of the cephalic lobe. Palps broad, subulate; to the naked eye quite smooth, but found with the microscope to be densely covered with minute papillæ. Elytra fifteen or twenty pairs, usually covering the whole back, placed on 1, 3, 4, 6, 8

. . . . . . 22, 25, 28, 31, or 32, 35, 38, 41 truncal somites *. Setæ of notopodium slightly attenuated towards the apex, with minute spicules disposed in dense transverse series. Setæ of the neuropodium thinner and longer, and transversely spinate from the bidentate apex. Two pygidial (anal) cirri beneath the anus.

HARMOTHOË SARNIENSIS, n. sp.

Corpus elongatum, postice attenuatum; somitibus truncalibus 47. Lobus cephalicus latior quam longior, margine antico late inciso, in prominentias duas angulares a latere producto; oculi 4, duo anteriores in lateribus prominentiarum, sub apice earum siti. Antennæ longitudine lobi cephalici. Tentaculum antennis triplo longius, articulo basali conspicuo. Cirri peristomiales magnitudine et formâ tentaculi; omnes filiformes, oculo nudo glabro, apice magnitudine aucto. Elytra paria 20, non semper totum dorsum tegentia, primo pari suborbiculari excepto, ovali-reniformia vel oblique ovata, oculo nudo glabro, margine externo sæpe, in junioribus semper, breviter et paullo ciliato. Cirrus notopodialis trunci latitudinem longitudine æquans, eâdem formâ et colore ac cirri peristomiales. Cirrus neuropodialis brevior, subulatus. Papilla ventralis distincta, cylindrico-conica, insertionem cirri neuropodialis fere attingens. Cirri pygidiales duo sub ano, cirris notopodialibus simillimi sed longiores.

Color.—Elytrorum variat, in plerisque brunneus variegatus, sæpe griseus, et sæpissime deest. Setæ fulvæ. Truncus lineis fuscis inter somites notatus.

Longit. 4–5 centimetres.

Latit. 8–9 millimetres (cum setis).

Hab. vulgatissime ad oras orientales insulæ Sarniæ (Guernsey), et ad oras occidentales insulæ Hermi.

Tab. LI. fig. 14. *Harmothoë Sarniensis*; fig. 10. Pars cephalica, aucta; figs. 15, 16. Elytra; fig. 24. Valde aucta elytri pars.

The species above described is very abundant under stones near the low-water mark at Guernsey and Herm. It is remarkably active, and has the habit, so common and fatal among this beautiful group of Annelids, of breaking up into bits when touched. Its chief peculiarity is the presence of twenty pairs of scales—a larger number than has, I believe, been met with in any of the allied gibbous Polynoïna. In many respects it is closely related to the *Lepidonotus cirratus* of Johnston (*Harmothoë imbricata*, Malmgren), to which in colour it is very similar, whilst the head does not differ much in form, and the setæ are identical. The presence of twenty pairs of scales, however, and the consequent presence of forty-seven truncal somites, seems to draw a very marked line between the two species; whilst, moreover, in *H. Sarniensis* the scales frequently leave a portion of the body of the animal exposed between them in the middle line, and are very delicate and small. In Guernsey and Herm not a single specimen referable to *H. imbricata* (*Lepidonotus cirratus*) occurred. Its place seems to be entirely supplied by this species. The special food of *H. Sarniensis* is, I believe, small mollusca and Nemertians.

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* In Prof. Malmgren's and other works, the somites are spoken of as "segments," and are separated as "segments provided with feet" and "segments destitute of feet."

HARMOTHOË MALMGRENI, n. sp.

Corpus oblongum, ovatum, postice attenuatum; somitibus truncalibus 37. Lobus cephalicus latior quam longior, margine antico recte inciso, nec lateraliter producto; oculis 4, duo anteriores laterales, duo posteriores in vertice. Antennæ longitudine lobi cephalici, articulis basalibus. Tentaculum antennis ter longius, articulo basali elongato. Cirri peristomiales magnitudine et formâ tentaculi, articulo basali valde elongato. Cirri buccales conspicui. Palpi permagni, crassi, apice attenuati. Elytra, primo pari suborbiculari excepto, ovali-reniformia, glabra, tenuissima, pellucida. Setæ notopodiales setis *H. imbricatæ* simillimæ. Setæ neuropodiales longæ, tenues, spinulis longis usque ad apicem armatæ.

Color.—Elytra sine colore. Setæ fulvæ.

Longit. 50 millim.

Latit. 10–11 millim.

Hab. in tubulis *Chætopteri insignis* ad oras insulæ Hermi.

Tab. LI. fig. 11. Pars cephalica, aucta; fig. 25. Elytron, auctum; fig. 28. Seta neuropodialis, aucta.

This species, which I have named after M. Malmgren, who has done so much good work among the Annelids, as well as in other branches of zoology, was found in the tube of a *Chætopterus*, which is by no means rare at Herm. It appears to be only met with in this habitat, and I would just draw attention to the fact that nearly all the Polynoïna are thus parasitic *. Dr. Baird mentions a species of *Lepidonotus* as occurring in the tubes of a *Chætopterus* from Anglesea (which he has called *Ch. insignis*), and I have seen the specimens in the British Museum; it is, however, quite distinct from *H. Malmgreni*, and much more closely allied to *H. imbricata* (*L. cirratus*). The horizontal direction of the anterior margins of the cephalic lobes, and the absence of anything like a prolongation of their frontal margins, together with the presence of a large basal protuberance for the antennæ, are the points chiefly noticeable in this species. The scales also are of very great tenuity. The colour and form also of the cirri and their homologues are characteristic.

ANTINOË (Kinberg).

Antennæ arising from the base of the tentacle, which occupies a frontal incision of the cephalic lobe. Palps subulate, densely covered with very minute papillæ. Elytra fifteen pairs (in smaller forms only thirteen to fourteen), covering the whole back. Notopodial setæ divaricate, towards their extremity densely transversely spinulose, (excepting the innermost) a little curved, shorter and much broader than the setæ of the neuropodium; these are capillary, numerous, spinulous, much elongated, with a very fine apex. Two pygidial cirri beneath the anus.

ANTINOË NOBILIS, n. sp.

Corpus oblongum, utrinque fere equaliter obtusum; somitibus truncalibus 30–36. Lobus cephalicus æque longus ac latus, antice et postice valde incisus, antice in duas prominentias conicas productus; oculi 4, duo postice in vertice, duo antice majores laterales. Antennæ minutæ, deciduæ, tamquam a prominentiis lobi cephalici orientes sitæ. Tentaculum prostomiale inter prominentias frontales magno articulo basali insertum, dense ciliatum, apice aucto, lobo cephalico plus quam ter longius. Cirri peristomiales formâ et magnitudine tentaculi. Elytra dura, tuberculis nodulisque duris armata, primo pari suborbiculari excepto reniformia, margine tuberculis acutis valde dentato postice et externe parce ciliato. Cirrus notopodialis pyriformis, sacculatus, ciliatus, brevis. Cirrus neuropodialis subulatus, breviter ciliatus. Papilla ventralis conspicua.

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* Prof. Huxley mentions a species in his lectures which he has called *P. astericola*, from its infesting *Uraster*.

Color.—Elytra brunnea, pellucida, pulcherrime maculata. Truncus passim aurantiaco-ruber. Setæ fulvæ.

Longit. 3½–4½ centimetres.

Latit. 1–1·2 centimetres.

Hab. haud vulgatissime ad oras occidentales insulæ Hermi, fundo lapidoso.

Tab. LI. fig. 1. *Antinoë nobilis*; fig. 2. Pars cephalica, aucta, dorsum; fig. 4. Pars cephalica, aucta, ventrum; fig. 3. Parapodium; fig. 5. Elytron, valde auctum; fig. 6. Pars elytri; fig. 7. Cirrus notopodialis; fig. 8. Seta notopodialis; fig. 9. Seta neuropodialis.

This very handsome species I obtained only at Herm, and there by no means commonly. It was invariably found close to and in the tubes of *Terebella nebulosa*, on which Annelid it apparently feeds. The bright salmon-red colour of both is remarkable. Nearly every species of Polynoïna appears to have its special victim; and *T. nebulosa* undoubtedly serves this form.

The remarkable form of the notopodial cirri in this species is well worthy of attention; they are invariably as it were inflated, so as to have an almost globular appearance, instead of being filiform as is usual. The only other, similar instance I have noticed is in a species described by Schmarda as *Gastrolepidia clavigera*.

The colour of the optic lobes is violet, whilst the palps, which are long and excessively sensitive, are deep madder-brown; the orange-red colour of the body, which is seen through the tough but translucent elytra, renders this a very fine-looking species. The peculiar dentation of the edges of the elytra and their other markings (see plate) are produced by the extraordinary development of the marginal cells, which are usually simply disposed in the tissue of the scale. The growth of these cells is such that they press one against another, and thus become hexagonal and elongated where the lateral pressure is greatest.

I have had some doubts as to whether this form rightly belongs to Kinberg's genus *Antinoë*, but I am unwilling to multiply names at present by instituting a fresh genus for its reception.

In the British Museum there is a large specimen of this species without its elytra or cirri, labelled *Lepidonotus semisculptus*, Leach. On turning to the catalogue lately published, I find the description of a very different worm and a reference to a drawing of a *Lepidonotus* with twenty pairs of scales, which is rather puzzling. Hence I conclude that this species is certainly not the *L. semisculptus* of Leach, whose original type has been lost.

ANTINOË ZETLANDICA, n. sp.

Corpus late pyriforme, antice latius, postice subito attenuatum. Lobus cephalicus æque longus ac latus, antice duas prominentias maximas præbens; oculi 4, duo postici in vertice, duo antici laterales. Antennæ filiformes, lobo cephalico sesquilongiores. Tentaculum inter prominentias frontales insertum, articulo basali magno. Palpi validi, percrassi. Elytra densa, dura, tuberculis marginalibus, primo pari suborbiculari excepto reniformia.

Color.—Elytra brunnea, interne margaritacea. Setæ fulvæ.

Longit. 50 millim. (circiter).

Latit. 35 millim. (circiter) cum setis.

Hab. ad oras Zetlandicas.

Tab. LII. fig. 13. Pars cephalica, aucta; figs. 17, 18. Elytra; fig. 22. Seta neuropodialis; fig. 23. Seta notopodialis.

This species was dredged by Mr. Gwyn Jeffreys in Shetland, and deposited by him in the British Museum. It is chiefly remarkable for its great breadth and the large size of some of its elytra and setæ. The tentaculum is deficient in the specimen, and some of the elytra also.

HALOSYDNA, Kinberg.

Cephalic lobe anteriorly tripartite, for the purpose of forming the bases of the prostomial tentacle and of the antennæ. Elytra eighteen to twenty-one pairs, not always covering the back, extending to the end of the body, but not affixed to the few posterior somites.

Subgenus ALENTIA, Malmgren.

Body linear oblong. Elytra eighteen pairs, on the following truncal somites: 1, 3, 4, 6, 8 . . . . . 22, 25, 28, 31, 34, 37, 38. Setæ of the notopodium hair-like, not numerous, very obscurely serrulate. Setæ of the neuropodium much longer and broader than the others, numerous, bidentate at the apex, with very few spinules.

HALOSYDNA (ALENTIA) JEFFREYSII, n. sp.

Corpus lineare depressiusculum, utrinque æqualiter obtusum; somitibus truncalibus 43. Lobus cephalicus latus, lateribus rotundatis; oculis 4, utrinque duo approximati. Tentaculum lobo cephalico quadruplo longius. Antennæ et cirri tentaculares formâ et longitudine tentaculi. Palpi validi, crassi, glabri, his longiores. Elytra tenuissima, mollia.

Color.—Truncus brunneo-violaceus, lobus cephalicus purpureus. Setæ fulvæ.

Longit. 60–70 millim.

Latit. 14–16 millim. (cum setis).

Hab. ad oras insulæ Hermi et Britanniæ australis.

Tab. LI. fig. 12. Pars cephalica, aucta; figg. 19, 20, 21. Somites truncales 1, 2, 3; figg. 26, 27. Setæ.

This species, which I met with at Herm, is, I believe, the same as that named *Lepido-*

notus imbricatus in the British Museum, and briefly noticed in the Catalogue. The *Aphrodita imbricata* of Linnæus is considered by Malmgren to be identical with *L. cirratus* of Johnston and Audouin and Milne-Edwards; and hence the name *imbricatus* must be changed. I propose to give the specific title *Jeffreysii* to this form, in honour of my friend Mr. Gwyn Jeffreys, F.R.S., through whose kindness I have been able to make these few remarks on the Annelida of Guernsey. The *Alentia gelatinosa* of Sars, Kinberg, and Malmgren appears to be very closely allied, and may perhaps turn out to be but a boreal form of the same species. The description which I have given above is very similar to that given by Malmgren of *A. gelatinosa.*

DESCRIPTION OF THE PLATE.

Plate LI.

Fig. 1. *Antinoë nobilis,* n. sp., natural size. Herm.

Fig. 2. Head of *A. nobilis,* viewed from above: *a,* prostomial tentacle; *b,* base of the prostomial tentacle; *c,* antennæ; *d,* cephalic or optic lobes; *e,* palps; *f,* peristomial cirri.

Fig. 3. Parapodium and appendages of *A. nobilis.*

Fig. 4. Head of *A. nobilis,* viewed from below: letters as before; *g,* neuropodial cirrus of the first truncal somite, or "buccal cirrus."

Fig. 5. Elytron of *A. nobilis,* highly magnified, showing the peculiar arrangement of the endoplasts.

Fig. 6. A portion of the margin of the same elytron, viewed from below.

Fig. 7. Neuropodial cirrus of *A. nobilis.*

Fig. 8. Notopodial seta of *A. nobilis.*

Fig. 9. Neuropodial seta of *A. nobilis.*

Fig. 10. Head of *Harmothoë Sarniensis,* viewed from above. Letters as before.

Fig. 11. Head of *Harmothoë Malmgreni,* viewed from above. Letters as before.

Fig. 12. Head of *Halosydna Jeffreysii,* viewed from above. Letters as before.

Fig. 13. Head of *Antinoë Zetlandica,* viewed from above. Letters as before. The peristomial cirri and the prostomial tentacle are wanting.

Fig. 14. *Harmothoë Sarniensis,* natural size. Guernsey.

Figs. 15, 16. Elytra of *H. Sarniensis.*

Figs. 17, 18. Elytra of *A. Zetlandica,* twice natural size.

Fig. 19. First truncal somite of *H. Jeffreysii.*

Fig. 20. Second ditto.

Fig. 21. Third ditto.

Fig. 22. Neuropodial seta of *A. Zetlandica.*

Fig. 23. Notopodial seta of *A. Zetlandica.*

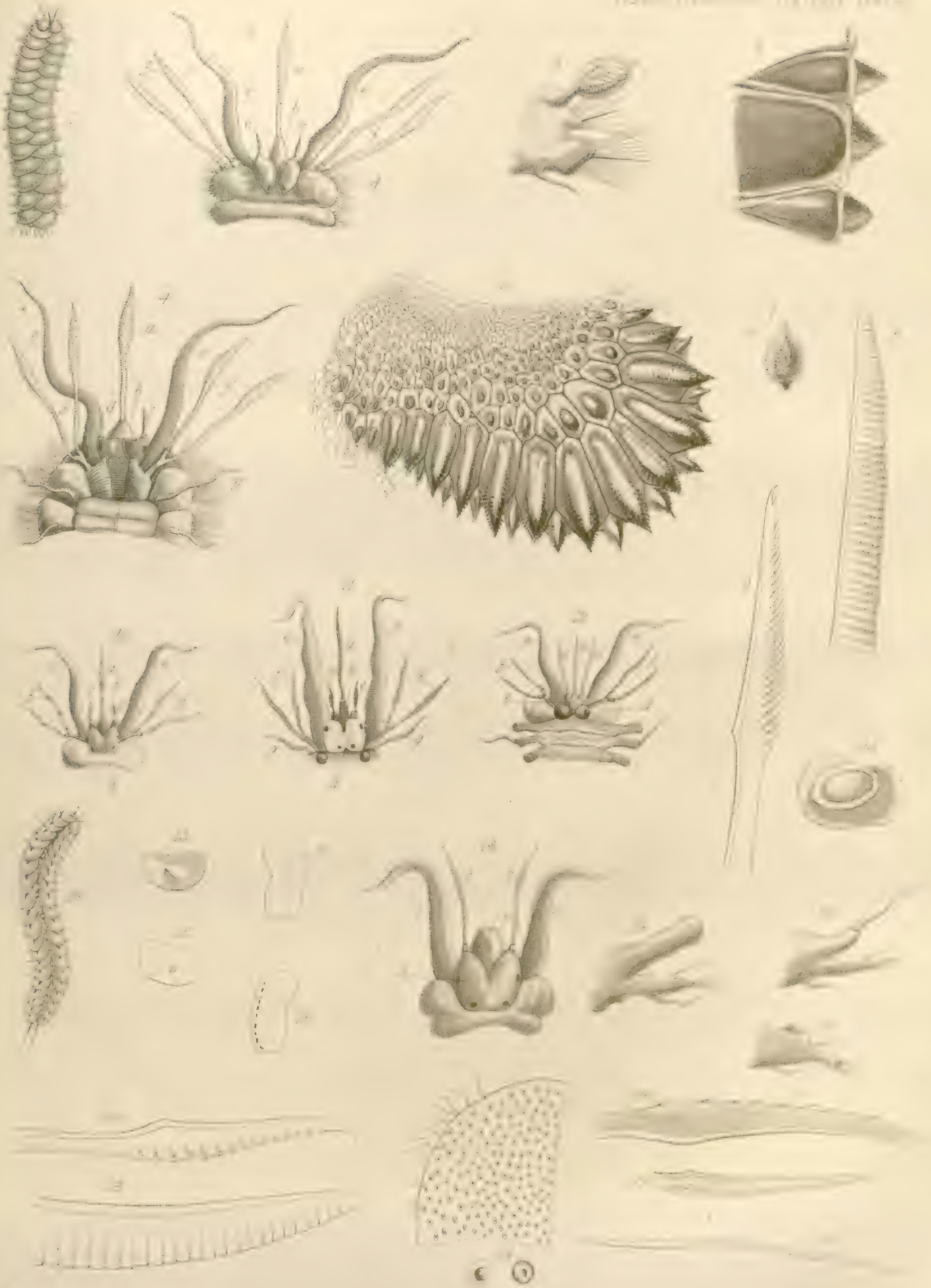
Fig. 24. Portion of the elytron of *H. Sarniensis.*

Fig. 25. Elytron of *H. Malmgreni.*

Fig. 26. Neuropodial seta of *Halosydna Jeffreysii.*

Fig. 27. Notopodial seta of ditto.

Fig. 28. Neuropodial seta of *H. Malmgreni.*



XIV. *On some points in the Anatomy of* Echidna hystrix. *By* St. George Mivart, *Esq., F.L.S., Lecturer on Comparative Anatomy at St. Mary's Hospital.*

(Plates LII. & LIII.)

Read February 1st, 1866.

Having had, through the kindness of my friend Mr. W. H. Flower, the opportunity of dissecting a specimen of that very interesting animal the Echidna, I now beg to lay before the Society the results of my observations.

Those observations have been almost exclusively directed to the myology of the animal, that part of its anatomy being, so far as I have been able to ascertain, as yet undescribed.

My specimen having, I believe, been caught in a trap, and having had its head completely crushed, I am unable to give any account of the muscles of that part of the creature.

Muscles of the Trunk.

Panniculus carnosus.—This muscle, as in the Ornithorhynchus[1], is remarkable for its thickness. It invests the whole body and limbs, and is strongly adherent to the skin, its fibres being inserted into the bases of the spines, which are erected by their contraction. It consists mainly of a large superficial muscular layer with certain deeper portions, and is firmly attached to the neck and tail and distal portions of the ulna (Plate LII. fig. 1, *P.c*) and tibia.

Trapezius (Plate LII. fig. 1, tz).—This muscle, as in the Ornithorhynchus[2], consists of two parts. The posterior part is triangular, and arises from the last eleven dorsal and the first lumbar vertebræ. The origin from the most anterior vertebra is muscular; but posterior to this the *trapezius* arises by strong tendinous fibres, which are successively longer from before backwards. It is inserted into the anterior two-thirds of the vertebral margin of the scapula. The anterior part arises from the occiput and the tendinous raphe connecting it with its fellow on the opposite side, and is inserted into the whole length of the spine and acromion, and also into the more anterior part of the vertebral margin of the scapula and into the outermost end of the clavicle.

Rhomboideus.—There appears to be but one rhomboid; and this arises from the occiput and midline of the back of the neck, and is inserted into the anterior two-thirds of the vertebral margin of the scapula opposite the insertion of the posterior part of the *trapezius*.

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[1] Meckel, '*Ornithorhynchi paradoxi* Descriptio Anatomica,' (Leipsic, folio, 1826), p. 22; and Owen, article "Monotremata," in Todd's 'Cyclopædia,' vol. iii. p. 379.

[2] Meckel, *loc. cit.* p. 23; Owen, *loc. cit.* p. 379.

Latissimus dorsi (Plate LII. figs. 1 & 3, L.D 1 & L.D 2).—There are two distinct muscles, which seem to me together to represent the *latissimus dorsi.*

The posterior one of these is very elongated, and is triangular in shape from its origin as far as the elbow. It arises, by digitations, from six ribs (namely, from the eighth to the thirteenth), and, becoming narrower, passes beneath the interior condyle. A little below the middle of the forearm it becomes intimately united with the surface of the *flexor carpi ulnaris.* The anterior muscle is wider but shorter than the preceding; it arises from the spines of the first eleven dorsal vertebræ, and also somewhat from the *fascia lumborum.* It is inserted into the inner condyle of the humerus, in union with what appears to be the *dorso-epitrochlear.*

Serratus posticus.—I did not observe the presence of any *serratus posticus*; and both Meckel and Owen are silent respecting its existence in the Ornithorhynchus.

Splenius.—This muscle arises from the spines of the most anterior dorsal vertebræ and from the midline of the back of the neck, and is inserted into the posterior part of the cranium towards the outer side.

The *sacro-lumbalis* is weak and thin, and, leaving the common mass of the *erector spinæ,* is inserted into all the ribs. It is rather widely separated from the outer margin of the *longissimus dorsi.*

The *cervicalis ascendens* is represented by the single fasciculus and tendon of the *sacro-lumbalis,* which is inserted into the transverse process of the seventh cervical vertebra.

Longissimus dorsi, spinalis, semispinalis, and multifidus spinæ.—As in the Ornithorhynchus[1], these muscles are united into a more or less inseparable mass, which extends along the spine from the sacrum to the neck, long and superficial tendons being inserted into the spines of all the vertebræ from the fourth cervical to the last dorsal.

The *transversalis cervicis* is the continuation upwards of the preceding; it arises from the transverse processes of about the six most anterior dorsal vertebræ, and is inserted by distinct tendons into the similar processes of the sixth, fifth, fourth, third, and second cervical vertebræ.

The *trachelo-mastoid* is placed just within the preceding; it arises from the transverse processes of the second, third, fourth, and fifth cervical vertebræ, and is inserted into what appears to be the mastoidal region of the skull, behind and beneath the insertion of the *sterno-mastoid.*

Complexus.—This is rather largely developed; it arises from the transverse processes of the cervical and the first two or three dorsal vertebræ, and has a strong tendinous insertion into the skull.

The *rectus capitis posticus major* and *minor*, as well as the *obliquus capitis superior* and *inferior*, are all normal; but the *obliquus superior* is very large, thick, and strong.

The *rectus lateralis* has also the usual origin and insertion.

Rectus capitis anticus major.—This muscle is remarkably prolonged, being relatively almost as long as, though much more slender than, in *Nycticebus tardigradus*[2]. It arises from the ventral surfaces of the bodies of first three dorsal vertebræ, and is inserted by a strong tendon into that part of the basis cranii which appears to answer to the styloid process; but the mutilated condition of the skull of my specimen renders this determination a little uncertain.

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[1] Meckel, *loc. cit.* p. 24.

[2] See Proceedings of Zool. Soc. for 1865, p. 241.

The *rectus capitis anticus minor* arises from the transverse process of the axis, and is inserted into the base of the skull within the tendon of the muscle last described.

Longus colli.—This muscle is very weak and small, the Echidna thus differing from the Ornithorhynchus[1], as might be expected from the difference in the development of the hypapophysial processes. It arises from the ventral surfaces of the first six dorsal vertebræ, and from the transverse processes of the cervical vertebræ as far forwards as the axis, and is inserted into the transverse processes of the last two or three cervical vertebræ and into the bodies of all the cervical vertebræ, especially into the hypapophysis of the atlas, by strong tendinous fibres.

Scalenus.—There appears to be but a single *scalenus* muscle, which arises from the transverse processes of the cervical vertebræ, from the second to the seventh inclusive, and is inserted into the first rib. The brachial vessels and nerves pass out beneath (in front of) it.

The *sterno-mastoid* (Plate LII. fig. 2, S.M), a very long and narrow muscle, arises, in close connexion with its fellow of the opposite side, from the middle of the outer surface of the manubrium. It is inserted by a strong tendon into the mastoidal region of the skull above and in front of the insertion of the *trachelo-mastoid.* It is an interesting fact that the sterno-mastoid does not arise from the anterior border of the shoulder-girdle, but, as it were, follows its own normal point of attachment (the manubrium) backwards behind the episternum. Meckel[2] represents it, however, as arising from the clavicle in the Ornithorhynchus.

The *sterno-thyroid* and *sterno-hyoid* arise deeply within the thorax, namely, from the internal surface of the true sternum as far back as the attachment of the fifth rib. The *sterno-hyoid* passes upwards beneath the larynx, and appears to be continued on into the *hypoglossus*, as in the Ornithorhynchus[3].

The *external oblique* arises by digitations from all the ribs except the first, and from the ilium. It is inserted by a strong tendon into the anterior (upper) border of the symphysis pubis, into the internal and external margins of the marsupial bone, and has another strong tendinous insertion into the margin of the pubis just external to the base of the marsupial bone. The tendinous fibres of this muscle decussate with those of its fellow on the opposite side.

The *internal oblique* is exceedingly thin and delicate; it arises from the ilium, and is inserted into the expanded cartilages of the false ribs.

Transversalis.—This muscle, as in the Ornithorhynchus[4], is more developed than the preceding. It arises from the ilium, the transverse processes of the lumbar vertebræ, and from within the expanded cartilages of the ribs. Its aponeurosis blends with that of its fellow of the opposite side above (*i. e.* behind) the *rectus.*

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[1] Meckel, *loc. cit.* p. 26.

[2] See *loc. cit.* tab. v. no. 8.

[3] Owen, *loc. cit.* p. 381.

[4] Meckel, *loc. cit.* p. 25, and Owen, *loc. cit.* p. 381.

The *pyramidalis* is very largely developed, and lies immediately beneath the tendinous aponeurosis of the *external oblique.* It arises from the whole inner surface of the marsupial bone, and from its internal margin within the insertion of the external oblique. Its superficial fibres radiate towards the middle line of the body (those fibres arising from the distal part of the marsupial bone being much the longest), and are inserted into the linea alba from the symphysis pubis to the posterior end of the sternum; its deeper fibres blend with with those of the *rectus.*

Rectus abdominis (Plate LII. fig. 2, R.).—This arises from the deep surface of the marsupial bone, towards its external margin. It proceeds forwards, and is partly inserted into the posterior end of the sternum (near which point it is intimately connected with the *external oblique*) ; it then continues on, being inclined somewhat outwards, and is inserted into the first rib, the manubrium, and, very slightly, into the coracoid, close to the origin of the *coraco-brachialis* and *biceps.*

The *sacro-coccygeus* arises from the ventral surfaces of the sacral and first few caudal vertebræ, and is inserted by strong tendons into the ventral surfaces of the caudal vertebræ, a little posterior to a point opposite the tuberosity of the ischium.

The *pubo-coccygeus* forms a delicate sheet of muscular fibre, and arises from the whole anterior (superior) margin and inner surface of the pubis, and from the inner surface of the ilium. It is inserted into the ventral surface of the caudal vertebræ, just opposite to the tuberosity of the ischium. The portion arising from the ilium is probably the *ilio-coccygeus,* here united with the *pubo-coccygeus.*

Ischio-coccygeus.—This arises from the whole superior (posterior) margin of the ischium, from the acetabulum to the tuberosity; it is inserted into the transverse processes of the caudal vertebræ for about an inch posterior to a point opposite the tuberosity of the ischium.

Levator caudæ.—This continues, as it were, the *erector spinæ* backwards along the groove between the neural spines and the transverse processes of the caudal vertebræ.

Muscles of the Fore Limb.

Pectoralis major (Plate LII. fig. 2, P).—This is a large muscle, arising from the whole length of the sternum and from the greater part of the median portion of the interclavicle[1], or episternum, also somewhat from the aponeurosis of the *external oblique,* but not at all from the clavicle or from the lateral branches of the interclavicle. Its fibres converge to a strong tendon, which is inserted into the greater tuberosity of the humerus, where it is superficial to the insertion of a deeper layer of the *panniculus carnosus,* while an outer layer of that muscle is superficial to it.

I could find no muscle evidently representing a *pectoralis minor*; but there is a small and thin muscle which arises from the anterior border of the first rib for the greater part of its length, and which is inserted into the coracoid immediately behind (or rather above) the origin of the *coraco-brachialis.* I am inclined, however, to regard this muscle as the representative of the *subclavius*. Meckel is silent as to both; but Owen[1] says that both a *pectoralis minor* and a *subclavius* are inserted into the coracoid in the Ornithorhynchus.

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[1] A name suggested by W. K. Parker, Esq.

"*Epicoraco-humeral*" (Plate LII. fig. 2, E.H).—A small muscle, with a few tendinous fibres at its insertion, arises from the outer surface of the epicoracoid, lying deeper than the interclavicle, the outer margin of which is superficial to it. It is inserted into the humerus, in a groove situated between the prominence for the insertion of the *pectoralis* and that for the insertion of the *supraspinatus*, and also on a ridge running thence downwards. This muscle answers neither by its origin nor insertion to either the *pectoralis minor* or to the *subclavius*. It is evidently the muscle described and figured by Meckel[2] as the anterior portion of the *deltoid*; but, in the Echidna, we have, in addition to this muscle, another, which appears to be wanting in the Ornithorhynchus (judging from Meckel's figures), and which is evidently the anterior part, if not the whole, of the *deltoid*. Inasmuch as the epicoracoid is the representative in the shoulder-girdle of the pubis in the pelvic one, it is not impossible that this muscle may be the serial homologue of the *pectineus*, or of the *obturator externus*—more probably the former, on account of its insertion.

The muscle which, in the common fowl, arises from the inner border of the coracoid and the outer margin of the clavicle, and is inserted into the great tuberosity of the humerus immediately above the attachment of the great pectoral, greatly resembles the muscle which I have provisionally called "*epicoraco-humeral*" in the Echidna.

Serratus magnus and *levator anguli scapulæ* (Plate LII. fig. 1, S.M).—These muscles together form one large and thick layer, arising from the first four ribs and from the transverse processes of all the cervical vertebræ from the seventh to the axis inclusive, and being inserted into the whole vertebral border of the scapula and the uppermost fourth of its spine, and into the vertebral surface of the scapula, for some distance within the margin.

There is much tendon interspersed in the muscular mass, the tendons being visible on that surface of the muscle which is turned towards the neck and trunk. The tendon arising from the axis is strongest and most marked; that from the third cervical vertebra almost equals it; the more posterior ones are less and less conspicuous.

The *omohyoid* is long and very slender; it arises from the inner surface of the scapula, very deep down, but in its normal relation to the *supra-spinatus* muscle; it is inserted into the hyoid.

Levator claviculæ (?).—There are two flat and rather thin bands of muscular fibre which are closely connected at their origin, and together appear to represent this muscle.

The first of these arises, by a tendinous aponeurosis, mainly from the ventral surface of the atlas, but partly also from the basioccipital, and is inserted into the end of the acromion, and a little also into the outermost end of the clavicle. At its origin it is closely connected with, but superficial to, the next muscle.

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[1] *Loc. cit.* p. 381.

[2] *Loc. cit.* p. 26, and tab. v. no. 19; and Owen, *loc. cit.* p. 381.

This second part arises, by aponeurosis, mainly from the basioccipital, extending much further forwards than the origin of the first part. It is inserted into the anterior (superior) part of the vertebral margin of the scapula.

Deltoid (Plate LII. figs. 1 & 2, D 1 & D 2).—This appears to consist of two parts,—the first a triangular muscle, arising from the whole length of the clavicle and lateral branch of the interclavicle and from the terminal portion of the acromion: it is inserted into the prominence continuous with the greater tuberosity of the humerus, external to and rather below the insertion of the *pectoralis*.

The second part is a long and narrow muscle, with a long and strong tendon of insertion. It arises from the anterior vertebral angle of the scapula, and is inserted into a depression in the deltoid crest of the humerus, its tendon being implanted in the midst of the fibres of insertion of the first-described portion of the muscle.

Supraspinatus (Plate LII. fig. 2, S.S).—This muscle has a very extensive origin, arising as it does from almost the whole of the inner surface of the scapula not occupied by the insertion of the *serratus magnus*. It is inserted by a strong tendon into the summit of the greater tuberosity of the humerus immediately internal to the *infraspinatus*, with which it is, at its insertion, closely connected.

Professor Owen has pointed out[1] that the supraspinous fossa is on the inner surface of the scapula, through the peculiar development of the spine. In the Ornithorhynchus this muscle must be considerably smaller than in the Echidna, owing to the situation of the *subscapularis* in that genus.

The *infraspinatus* (Plate LII. figs. 1 & 2, I.S) arises from the surface of the scapula, between the long head of the *triceps* and the free margin of the spine and acromion (the actual anterior margin of the scapula); it is inserted into the greater tuberosity of the humerus, closely connected with the muscle last described. The muscle in the Ornithorhynchus which is figured by Meckel (tab. vii. no. 13), and named by him "*deltoides*," appears to be the same as that which I have named *infraspinatus* in the Echidna.

Teres minor.—This muscle appears to be wanting in the Echidna, unless it is represented by the muscle which I have described as the second part of the *deltoid*.

The *teres major* (Plate LII. fig. 1, T.M) is a small muscle, and is tendinous both at its origin and insertion. It arises from the recurved posterior vertebral angle of the scapula, and is inserted into the prominent ridge running down from the lesser tuberosity of the humerus. This muscle appears to be considerably larger in the Ornithorhynchus[2].

Subscapularis (Plate LII. fig. 1, S).—This large muscle has a most anomalous situation, inasmuch as it is confined to the outer surface of the scapula. It arises, indeed, from the whole of that outer surface posterior to the origin of the long head of the *triceps*. It is inserted into the lesser tuberosity of the humerus by a very strong and wide tendon. In the Ornithorhynchus this muscle takes origin in part from the outer surface of the scapula, but mainly from its inner face, in the usual mode.

Dorso-epitrochlear (?) (Plate LII. fig. 1, D.E).—There is a long narrow muscle arising from the posterior extremity of the vertebral margin of the scapula, and from the posterior and outer side of the tendon of origin of the *teres major*. It passes downwards, and becomes intimately connected with the second part of the *latissimus dorsi*, in common with which it is inserted, by a very strong tendon, into the internal condyle of the humerus. This muscle appears to me to represent the *dorso-epitrochlear*. Its origin is very similar to that of the last-named muscle in the Hyrax[1], though its insertion is certainly different, and it might perhaps be regarded as a separate portion of the *teres major*.

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[1] *Loc. cit.* pp. 376 & 381.

[2] Meckel, *loc. cit.* p. 26, tab. vi. no. 15.

A small delicate muscle closely connected with the outer surface of the capsular ligament arises from the external surface of the scapula, just anterior to the lowest part of the origin of the scapular head of the *triceps*. It passes downwards and backwards, and is inserted into the anterior part of the lesser tuberosity of the humerus, immediately beneath, and in front of, the insertion of the *subscapularis*.

Coraco-brachialis (Plate LII. fig. 2, C.B).—This muscle is very largely developed, and consists of at least two distinct parts, one long and the other short. Both portions have a common origin, and arise from the distal end of the coracoid, and chiefly from that part of it which looks towards the first rib. The long part passes downwards, and is inserted into the internal condyle of the humerus and into a slight ridge running up obliquely from that condyle on the anterior surface of the bone. There is a good deal of tendinous fibre at the common origin; but that border of the long portion which is next the *biceps* is especially tendinous.

The short portion is inserted into the whole anterior face of the lesser tuberosity and into part of the wide bicipital groove, and is covered by the long portion. A similar division of the *coraco-brachialis* appears to exist in the Ornithorhynchus[2].

Besides this double *coraco-brachialis*, there is a small third portion, unless indeed it should be reckoned as a distinct muscle. This arises from the external part of the deep or inner surface of the epicoracoid, and is inserted, by a distinct tendon, into the lesser tuberosity of the humerus, close and somewhat superficial to the insertion of the *subscapularis*. At its innermost part it is intimately united with the adjacent portion of the short part of the *coraco-brachialis*. It appears to me not improbable that it may answer to the muscle which, in the common fowl, arises from the inner surface of the coracoid, and is inserted into the lesser tuberosity of the humerus.

Another small muscle arises from the inside of the epicoracoid, internal to (nearer to the middle line of the body than) the muscle (or portion of a muscle) last described. It passes downwards and inwards, and is inserted into the inside of the manubrium and base of the interclavicle.

The *biceps* (Plate LII. fig. 2, B.) has but a single head, thus differing from the Ornithorhynchus[3]. It is thick and fleshy near its origin, but towards its insertion expands in the direction of the long axis of the forearm. It arises mainly from the strong tendon of the *coraco-brachialis*, but also in part from the coracoid; and some fibres take origin from the epicoracoid. It is inserted into the radius in part, but also into the ulna as far back as the coronoid process, being intimately connected posteriorly with the insertion of the *brachialis anticus*. This insertion into both radius and ulna takes place in the Pig[1], and, according to Meckel[2], it is inserted, either wholly or in part, into the ulna in many animals.

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[1] See Proceedings Zool. Soc. 1865, pp. 339 (fig. 5, *D. e.*), 340.

[2] Meckel, *loc. cit.* tab. v. no. 22 & 25; and Owen, *loc. cit.* p. 381.

[3] Meckel, *loc. cit.* tab. v. no. 23 & 24; and Owen, *loc. cit.* p. 381.

Brachialis anticus.—This is a very small and delicate muscle, closely embraced externally by the *supinator longus*. It arises from the radial side of the shaft of the humerus, its origin extending from the lowest point of the insertion of the *deltoid* up to the tendon of origin of the external head of the *triceps*. It is inserted into the part of the ulna representing the coronoid process, the anterior margin of its tendon being closely united with the posterior margin of that of the *biceps*.

Triceps (Plate LII. fig. 1, T).—This is an enormously powerful muscle, and consists of two main portions, one arising from the scapula, the other from the humerus.

The scapular portion has a very elongated origin, extending from the humeral end of the axillary margin of the scapula, obliquely upwards and forwards, to near the anterior vertebral angle; it has a strong tendon at its lowest part, which passes inwards beneath the *subscapularis*. It is inserted by muscular fibres into the whole breadth of the olecranon.

The humeral portion covers the entire posterior surface of the shaft of the humerus, whence alone it takes its origin, with the exception of a small and more or less distinct slip, which arises by a marked tendon from beneath the posterior part of the greater tuberosity, immediately external to the origin of the *supinator longus*. It is inserted in common with the scapular portion; but it forms an arch (extending from the inner condyle to the olecranon), beneath which pass the inferior profunda artery and the ulnar and median nerves.

The musculo-spiral nerve passes between the tendon above mentioned and the rest of the humeral part of the *triceps*.

The *supinator longus* (?) is larger than the *brachialis anticus*. It arises from the posterior part of the radial surface of the humerus, its origin extending up beneath the small tendon of origin of the external part of the humeral portion of the *triceps*. Passing downwards, it becomes connected with the outer surface of the *brachialis anticus*, and is inserted into the anterior surface of the radius, on a line with and just above the insertion of the *pronator teres*, and just on the radial side of the insertion of the *biceps*, and on the ulnar side of the insertion of the *supinator brevis*.

The radial nerve passes down on the outside of this muscle, which is inserted internally to the *supinator brevis*.

The median and ulnar nerves, together with what appears to be the inferior profunda artery, pass round outside the conjoined insertion of the second part of the *latissimus dorsi* and *dorso-epitrochlear*. The median nerve, as in the Ornithorhynchus[3], passes through a bony canal; the ulnar nerve passes beneath the midst of the expanded origin of the *flexor carpi ulnaris.*

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[1] Meckel, 'Anat. Comp.' vol. vi. p. 286; and Prof. Huxley in his Hunterian course for 1865.

[2] *Loc. cit.* p. 283.

[3] Meckel, *loc. cit.* p. 34; Owen, *loc. cit.* p. 387.

In spite of the peculiar arrangement and position of the bones of the limb in the Echidna, the axillary artery lies (as in man) successively on the first rib, part of the *serratus magnus*, the tendon of the *subscapularis* and that of the *teres major.*

Extensor carpi radialis longior (Plate LII. figs. 1 & 2, E.R.L).—This is a narrow muscle, arising, as usual, from the external condyle of the humerus. It becomes tendinous a little below the middle of the forearm, and is inserted into the dorsal surface of the distal prominence of the scapholunar bone.

The *extensor carpi radialis brevior* (Plate LII. figs. 1 & 2, E.R.B) also arises from the external condyle. It exceeds in size the muscle last described, and becomes tendinous rather lower down. Its tendon passes, in common with that of the *extensor carpi radialis longior*, beneath the tendon of the *extensor ossis metacarpi pollicis*, and is inserted into the metacarpal bone of the third digit.

The *extensor communis digitorum* (Plate LII. figs. 1 & 2, E.C) is a wide, flat, somewhat laterally compressed muscle, its edge appearing on the surface of the forearm. It has two origins—one narrow one from the external condyle, the other, more extensive, from the radial side of the posterior margin of the ulna down nearly to the wrist. It is from this second origin that the tendon arises, which is very strong, passes downwards through a groove on the back of the ulna, lined with synovial membrane and enclosed by a very strong ligament, and, dividing into three, is inserted into the index and third and fourth digits.

Extensor minimi digiti (Plate LII. fig. 1, E.M.D).—This is very largely tendinous, and arises from the external condyle, and is at its origin closely united with the muscle last described and with the *extensor carpi ulnaris.* It is inserted into the dorsum of the fourth digit, after passing through a special groove, on the back of the ulna, lined with synovial membrane.

Extensor carpi ulnaris (Plate LII. fig. 1, E.U).—This arises from the external condyle and from the outer (radial) surface of the olecranon. It becomes tendinous a little above the wrist, its tendon passing along a distinct canal on the back of the ulna, lined with synovial membrane. It is inserted into the outer side of the dorsum of the fifth digit.

An *extensor indicis* appears to be entirely wanting.

Extensor ossis metacarpi pollicis (Plate LII. figs. 1 & 2, E.M.P).—This is a thin and delicate muscle, arising from the radial border of the ulna, as high up as the head of the radius, and from the interosseous ligament. A little above the wrist it gives origin to a rather strong tendon, which, after crossing over those of the radial extensors, is inserted into the metacarpal of the pollex.

Extensores primi et secundi internodii pollicis.—I could find no representative of either of these muscles.

The *supinator brevis* arises, by tendon, from the external condyle (immediately beneath the narrow origin of the *extensor communis digitorum*), also by muscular fibre from the same condyle, beneath the origin of the *extensor carpi radialis brevior.* It is inserted along the outer (radial) margin of the radius for nearly the upper four-fifths of that bone, immediately on the outer (radial) side of the insertions of the *supinator longus* and *pronator teres.* The posterior interosseous nerve is not given off from the radial, as in man, but is distinct at the back of the elbow; it traverses the *triceps,* and, passing over the external condyle (external to the radial nerve), it perforates the *supinator brevis.*

Anconeus.—This muscle is rather largely developed. It arises from the outer and posterior surface of the external condyle, and is inserted into the depression beneath the sigmoid cavity, on the radial surface of the ulna and olecranon.

The *pronator teres* (Plate LII. fig. 2, P.T) is a long and very strong muscle, arising from the internal condyle and the septum between it and the *flexor carpi radialis,* and being inserted intot he radial margin and anterior surface of the radius, from the lower end of the insertion of the *biceps,* almost down to the wrist.

The *flexor carpi radialis* (Plate LII. figs. 2 & 3, F.R) arises by a strong tendon from the internal condyle, also, by another tendon, from a depression on the ulnar side of the distal articular surface of the humerus, and, besides, by muscular fibre from the anterior surface of the lower border of the internal condyle. The fibres from these origins converge to a very strong tendon, which is inserted into the metacarpal bones both of the pollex and index.

The *palmaris longus* is fused with the enormous *flexor digitorum.*

There is no trace of a *pronator quadratus.*

Flexor carpi ulnaris (Plate LII. figs. 1, 2 & 3, F.U.).—This is an enormously wide sheet of muscle, which arises from the inner (ulnar) border of the olecranon and ulna down to the wrist, and also from the inner part of the lower border of theinternal condyle. Passing downwards, its tendinous surface receives the tendon of the first portion of the *latissimus dorsi*; and the two muscles becoming thus intimately united, are together inserted into the pisiform bone.

There is a muscular fasciculus (more or less distinct from the superior border of the *flexor carpi ulnaris*) which arises by strong tendinous fibres from the radial aspect of the extremity of the olecranon, and is inserted into the internal condyle immediately below the common insertion of the second portion of the *latissimus dorsi* and the *dorso-epitrochlear.* At its origin it is very closely connected with the adjacent fibres of insertion of the humeral part of the *triceps* on one side, and the fibres of origin of the *flexor carpi ulnaris* on the other. Of course it arches over the ulnar nerve.

Flexor communis digitorum (Plate LII. fig. 3, F.C).—There is a single, but enormous, muscular mass which appears to represent the *palmaris longus,* the *flexor sublimis,* the *flexor profundus,* and *flexor longus pollicis* all fused together. It arises from the whole length of the ulna, from the olecranon down to the wrist, and from the whole length of the inferior margin of the internal condyle, and forms (when the forearm is horizontal and the palm upwards) a vertically extended sheet of muscle, the narrow edge of which is visible on the surface. A small superficial portion, which arises from the extremity of the internal condyle and which is more or less separable from the rest, may perhaps represent the *palmaris longus.* The largest portion, which arises from the whole length of the internal condyle, appears to represent the *flexor sublimis,* as it is the part below, which is supplied by the anterior interosseous nerve (given off from the median, as usual), and which has the ulnar nerve passing along over it, and may therefore perhaps be considered to represent the *flexor profundus*.

The various parts give origin to a very large tendon, which divides into five, sending off a strong division to the last phalanx of each of the five digits. Each flexor tendon, except that one which goes to the pollex, is held down by a strong tendinous arch or loop, one such arch being fixed to the distal end of each metacarpal bone, except that of the pollex. A similar lateral compression of the muscle exists in the Ornithorhynchus[1], in which also there seems to be but a single flexor of the digits.

In the Echidna, as in the Ornithorhynchus, there are one or two ossicles in the palmar portion of the flexor tendon.[2]

Lumbricales.—I have only found four lumbrical muscles,—one pair arising between the flexor tendons of the index and middle digits, and going to the contiguous surfaces of those digits; the other pair arising between the flexor tendons of the middle and fourth digits, and going also to the contiguous side of those digits.

Abductor pollicis (?).—Some muscular fibres arise from the trapezium, and are inserted into the radial side of the pollex.

Interossei.—Two interosseous muscles arise from the palmar surface of the strong tendon of the *flexor carpi radialis*, and are inserted respectively into the outer and inner sides of the dorsal surface of the distal phalanx of the pollex. Two more arise from beneath the base of the metacarpal of the index, and are inserted, by very delicate tendons, one into the inner, the other into the outer side of the dorsal surface of the distal phalanx of the index.

Another, rather larger pair arises from beneath the os magnum, and the two muscles are inserted by delicate tendons into the third digit, in the same way as are the two last described into the index. Another, longer and very delicate interosseous muscle arises on the radial side of the continuation forwards of the tendon of the *flexor carpi ulnaris*, and is inserted into the radial side of the dorsum of the distal phalanx of the fourth digit. Another (the smallest of all) arises close to the proximal end of the metacarpal of the fourth digit, and is inserted into the ulnar side of the dorsum of the distal phalanx of the fourth digit.

Muscles of the Hind Limb.

Psoas parvus (Plate LIII. fig. 1, PS.P).—This, which is the largest of the subvertebral muscles, arises, by muscular fibres, from the last three ribs, and by small tendons, or by tendinous fibres, from the bodies of the last three dorsal vertebræ. Passing downwards, it gives origin to a very strong tendon, which is inserted into the summit of the large ilio-pectineal eminence, immediately behind the origin of the *sartorius*. It is thus very similar to its homologue in the Ornithorhynchus[1].

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[1] Meckel, *loc. cit.* p. 27.

[2] Meckel, *l. c.* p. 28; and Owen, *l. c.* p. 278, and page 377. fig. 175 *l.* As Meckel remarks, this palmar ossicle also exists in the Armadillos; and Professor Huxley, in his last Hunterian course (for 1865), mentioned its existence in *Dasypus sexcinctus*, as also the absence in that animal of any perforated flexor, and the union of the *flexor profundus* and *longus pollicis* to form one tendon. This point of similarity between the Monotremes and Edentates is the more interesting as my friend Mr. W. K. Parker informs me he has discovered singular points of resemblance in the sternal structure of those two groups.

The *psoas magnus* is a small muscle, and arises from the three lumbar vertebræ and, in a slight degree, from the first sacral vertebra. It becomes intimately blended with the *iliacus*, with which it has, of course, a common insertion into the lesser trochanter.

The lumbo-sacral nerve, which appears to become the main constituent of the sciatic, passes down through this muscle, or between it and the next described.

The *iliacus* (Plate LIII. fig. 1, I) arises from the whole ventral surface of the ilium, and, becoming inseparably united with the last, is inserted into the lesser trochanter and its enormous ridge-like prolongation, between the insertion of the *pectineus* and that of the *vastus internus*.

Quadratus lumborum.—This is a rather small muscle; it arises from the ventral surfaces and posterior margins of the last two ribs, and also from the sides of the bodies and the transverse processes of the three lumbar vertebræ. It is inserted, by strong tendinous fibres, into the anterior margin of the ilium.

I could find no *tensor vaginæ femoris*; nor does Meckel speak of its existence in the Ornithorhynchus.

The *sartorius* (Plate LIII. fig. 1, S) is a long and not very broad muscle, which arises by a narrow tendon from the ilio-pectineal eminence, and is broadly inserted into the tibia, in front of the internal lateral ligament.

The *gracilis* (Plate LIII. fig. 1, G) is exceedingly broad at its origin, which is the outer surface of the base of the marsupial bone and the whole symphysis pubis. It is inserted by a strong tendon into the back of the tibia, almost on its peroneal side and below the insertion of the *semitendinosus*.

This muscle and the preceding one much resemble their homologues in the Ornithorhynchus[2].

Semimembranosus (Plate LIII. fig. 1, S.M).—This muscle arises from the tuberosity of the ischium (being partly covered at its origin by the *semitendinosus*), and is inserted by a strong and very thick tendon into the inner side of the head of the tibia beneath (*i. e.* covered over by) the internal lateral ligament. Its insertion is situated only very slightly below that of the *sartorius*, but considerably above that of the *semitendinosus*.

The *semitendinosus* (Plate LIII. fig. 1, S.T) has a tendinous origin from the tuberosity the ischium, in close connexion with, and immediately superficial to, the origin of the *semimembranosus*. It is inserted into the posterior surface of the tibia by a rather small tendon, within and reaching very slightly above the insertion of the *gracilis*, and rather on the tibial side of that insertion.

The *biceps* (Plate LIII. figs. 1, 2 & 3, B) arises from the tuberosity of the ischium superficial to, and closely united with, the origin of the *semitendinosus*. Spreading out greatly, it is inserted into the fascia of the front of the leg, from the patella to the ankle.

Pectineus (Plate LIII. fig. 1, P).—This muscle is very narrow at its origin, but considerably expanded at its insertion. It arises, immediately beneath the origin of the *sartorius*, by a tendon, from the ilio-pectineal eminence, and is inserted into the *linea*

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[1] Meckel, *loc. cit.* p. 28; Owen, *loc. cit.* p. 381.

[2] Meckel, *loc. cit.* p. 29, and tab. v. 34 & 35.

aspera, closely connected with the adjacent surface of the upper part of the insertion of the *adductor brevis* and with the inner surface of the lowest part of that of the *iliacus.*

I could find no distinct *adductor longus*[1].

The *adductor brevis* (Plate LIII. fig. 1, A.B) arises from the base of the marsupial bone and from the whole *symphysis pubis* (its origin being almost conterminous with, and quite covered by, that of the *gracilis*), and is inserted, in common with the *adductor magnus*, into the *linea aspera* and internal condyle of the femur.

The *adductor magnus* (Plate LIII. fig. 1, A.M) is but of very moderate size; it arises (covered by the *semimembranosus*) from the tuberosity of the ischium, and is inserted into the very prominent *linea aspera* and, by a very strong tendon, into the internal condyle. At its insertion it is intimately blended with the *adductor brevis.*

Rectus femoris (Plate LIII. figs. 1 & 2, R).—This arises, as usual, from the part of the ilium which corresponds to the anterior inferior spinous process of Man; and passing downwards is inserted into the patella.

Vastus externus (Plate LIII. fig. 2, V.E).—This muscle arises from the whole outer surface of the front of the femur, from the very neck of the bone down almost to the external condyle, also from the depression between the head of the femur and the margin of the great trochanter. Joining the *rectus femoris* it is inserted into the patella.

The *vastus internus* (Plate LIII. fig. 1, V.I) arises from the whole inner surface of the front of the femur, from the neck of the bone down to the internal condyle, and from the depression anterior and external to the margin of the lesser trochanter. Joining the *rectus* it is also inserted into the patella.

Gluteus maximus (Plate LIII. figs. 1 & 2, G.MX).—There is a very large sheet of muscle which appears undoubtedly to represent the *gluteus maximus*; it arises, by aponeurosis, from the last sacral and the greater number of coccygeal vertebræ, and is, at its hinder margin, closely connected with the posterior part of the *panniculus carnosus.* The fibres converge, and the muscle, becoming thicker, passes to the ankle, where it is inserted for the most part into the lower half of the posterior surface of the tibia on its peroneal aspect, also into the ankle on the peroneal side of the tendon of the *tibialis posticus.* Some fibres also appear to pass to the front of the foot.

Gluteus medius (Plate LIII. fig. 2, G.MD).—There is a second muscle placed beneath the last described, but intimately connected with it at its origin, which arises, also by aponeurosis, from the spines of a few of the most anterior of those vertebræ which give origin to the muscle last described. It is inserted by a strong tendon into the lowest part of that long ridge, developed from the femur, which appears to be a great trochanter united with a third trochanter.

It may perhaps be that this muscle is a second and deeper portion of the *gluteus maximus*, especially as it is inserted into what appears to represent a third trochanter. If such be the true interpretation, it would represent that part of the human *gluteus maximus* which is inserted into the femur, while the preceding muscle would answer to that portion of it which ends in the fascia lata.

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[1] Meckel, *loc. cit.* p. 29, says that in the Ornithorhynchus there are two adductors arising from the pubis, but does not speak of one arising from the tuberosity of the ischium.

On the other hand, it is inserted just external to a muscle which I take to be the *pyriformis*; and this is (in Man) the insertion of the *gluteus medius*.

Gluteus minimus (and *scansorius*?) (Plate LIII. fig. 2, G.MI).—This is a very large though somewhat thin expanse of muscle. It arises, by aponeurosis, from the spines of the anterior sacral and last lumbar vertebræ, and by muscular fibre from the whole outer surface and anterior border of the ilium; also, by a very strong tendon, from that part of the ilium which answers to the anterior superior spinous process of Man. It is inserted, by strong tendinous fibres, into the upper end and whole anterior margin of the very elongated great trochanter.

If the muscle which I have called *g. medius* be only a deeper portion of the *g. maximus*, then this large sheet of muscle which I have named *g. minimus* may really be the *g. minimus* and *g. medius* united, unless, indeed, it represent the *g. medius* only; for there is a very small but distinct bundle of muscular fibres which arises from the ilium, just external to the tendon of origin of the *rectus*, and which is inserted into the great trochanter just within, and a little above, the middle of the insertion of what I have called *g. minimus*.

This little muscle may possibly be the true *g. minimus*[1]; and its insertion within and in front of what would then be the *g. medius* would harmonize with such a determination.

In the Ornithorhynchus[2] there are three large muscles very similar to those I have called *gluteus maximus*, *g. medius*, and *g. minimus*, and which Meckel has also so named.

Pyriformis (Plate LIII. fig. 2, PY).—There is a muscle which arises from the transverse processes of about five caudal vertebræ a little anterior to a point opposite the tuberosity of the ischium. It is inserted into the femur immediately above and slightly behind the insertion of the muscle I have called *gluteus medius*. I am disposed to consider that it is the *pyriformis*, although the great sciatic nerve passes out superficially to it, instead of the muscle being superficial to the nerve.

I could not find any trace of either a *gemellus superior* or *inferior*; neither was there any muscle in the place of the *obturator internus*, the muscular fibres situated immediately within the obturator foramen being those of the *pubo-coccygeus*.

The *obturator externus* arises from the external circumference of the obturator foramen, and is inserted, by a strong tendon, into the very shallow depression behind the great trochanter, just within, and more or less connected with, the lowest part of the insertion of the *quadratus femoris*.

Quadratus femoris.—This delicate muscle arises from the tuberosity of the ischium and from the whole inferior margin of the ischium, from the tuberosity to the acetabulum. It is inserted into the posterior margin of the great trochanter, almost from its upper extremity as far down as the insertion of the *obturator externus*, with the tendon of which it is more or less connected.

Tibialis anticus.—There are two muscles together representing the *tibialis anticus*. The more internal of these (Plate LIII. figs. 1, 2 & 3, T.A 1), *i. e.* the muscle on the extreme tibial side of the front of the leg, arises from the upper half of the inner surface of the tibia, anterior to the internal lateral ligament. About the middle of the leg it gives rise to a strong tendon, which passes down in a groove (lined with synovial membrane) on the anterior aspect of the tibial side of the lower part of the tibia and of the internal malleolus, and, passing beneath the tendon of the second part of the *tibialis anticus*, it is inserted into the dorsal surface of the entocuneiform.

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[1] The *g. minimus* is often very small, *e. g.* in *Nycticebus*, Proc. Zool. Soc. 1865, p. 249; and in *Cheiromys*, Trans. Zool. Soc. vol. v. p. 66.

[2] Meckel, *loc. cit.* p. 28, and tab. v. 24, 25, & 26.

The second and more external (Plate LIII. figs. 2 & 3, T.A 2) muscle is of about the same size as the preceding; it arises from the upper three-fifths of the anterior surface of the tibia, its fibres taking origin lower down than those of the first part; and its tendon passes in a marked groove (lined with synovial membrane) immediately external to the groove of the muscle last described, but quite distinct from it. It then crosses over the tendon of that muscle and is inserted into the dorsum of the proximal phalanx of the hallux, but gives off a small slip, which passes forwards and outwards and joins the tendon of the *extensor longus hallucis*.

Meckel[1] speaks of this muscle having two distinct heads in the Ornithorhynchus.

The *extensor longus hallucis* (Plate LIII. figs. 2 & 3, E.L.H), largely developed, though somewhat laterally compressed, arises from the upper half of the tibial border of the ulna and from the interosseous membrane. Its tendon passes down in a groove on the anterior surface of the bone, and is inserted into the last phalanx of the index of the foot towards its inner or tibial side.

In the Ornithorhynchus[2] this muscle is inserted into the hallux.

Extensor digitorum longus (Plate LIII. figs. 2 & 3, E.L.D).—This large muscle seems to be separable into two or perhaps three more or less distinct portions. It arises from the head of the fibula (slightly in front of, but principally behind, the lower attachment of the external lateral ligament), from the upper two-fifths of the tibial border of the fibula, from the intermuscular septa, and, very slightly, from the interosseous membrane. The main portion gives rise to a strong tendon, which divides into three, and is inserted into the second, third, and fourth digits.

A small and more or less distinct portion, on the peroneal side of the main part of the muscle, gives origin to a long and delicate tendon, which is inserted into the dorsum of the fourth digit.

In the right leg a third, also small portion, placed close beside the last, gives origin to a very delicate tendon, which is inserted into the fifth digit.

There appears to be a considerable difference between the Echidna and Ornithorhynchus[3] in the arrangement of the extensor muscles and tendons.

Extensor brevis digitorum.—I could find no trace of this muscle.

The *peronæus longus* (Plate LIII. fig. 3, P.L) is a large muscle, and arises from the anterior surface of the upper half of the fibula, including its singularly produced upper extremity. At about the commencement of the lowest fifth of the fibula it gives origin to a strong tendon, which descends and passes obliquely inwards (towards the tibia), and then dips down between the curiously reflected calcaneum and the peroneal border of the cuboid, and, running along a groove in the plantar surface of that bone, and crossing the sole of the foot, is inserted into the plantar surface of the proximal phalanx of the hallux.

The *peronæus brevis* and *peronæus tertius* are both wanting.

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[1] *Loc. cit.* p. 29.

[2] Meckel, *l. c.* p. 29, & tab. v. f. 38.

[3] Meckel, *loc. cit.* p. 29, & tab. v.

Gastrocnemius (Plate LIII. fig. 1, G.O).—This is a delicate and slender muscle, which has a single but broad origin extending obliquely upwards and inwards from the internal condyle of the femur. Rather below the middle of the leg it gives origin to a moderately strong tendon, which is inserted into the peroneal side of the os calcis.

Soleus (Plate LIII. fig. 1, S.O).—A muscle somewhat smaller than the *gastrocnemius*, and which I take to be the *soleus*, arises, by tendinous fibres, from the posterior and outer margin of the singular process at the summit of the fibula, but not at all from the tibia. In the middle of the leg it gives origin to a tendon (of about the same size as that of the *gastrocnemius*), which is inserted into the os calcis rather on its tibial side, therefore crossing over beneath the tendon of the muscle last described.

This muscle and the preceding one differ considerably from their homologues in the Ornithorhynchus[1].

The *plantaris* (Plate LIII. fig. 1, PLA) arises from the extremity of the posterior or inner surface of the process at the summit of the fibula, and about the middle of the leg gives origin to a tendon of nearly the same size as that of the *soleus*. This passes obliquely downwards towards the tibia and along a groove on the inner surface of the lower end of that bone, and is inserted into the plantar fascia.

The *popliteus* also arises from the extremity of the process at the summit of the fibula, instead of from the external condyle. Its fibres pass obliquely downwards and inwards, and are inserted into the posterior surface of the tibia. The muscle extends, as a very thin layer, a long way down on the back of the interosseous membrane.

Tibialis posticus (Plate LIII. fig. 1, T.P).—This is a very large and strong muscle. It arises from the whole posterior surface of the fibula, almost down to the ankle-joint, and gives origin to an extremely strong tendon, which is inserted into the plantar surface of the astragalus at its junction with the naviculare.

Flexor longus digitorum (Plate LIII. fig. 1, F.L.D).—A muscle about as large as the preceding. It arises from the upper two-thirds of the posterior and external (peroneal) surface of the fibula, between the origin of the *peronæus longus* and the *tibialis posticus*. Just above the distal end of the tibia it gives origin to a very strong tendon, which passes in a groove between the os calcis and astragalus, and then divides into five tendons, which are respectively inserted into the last phalanx of each of the five digits.

There seems to be no *flexor longus hallucis* or *flexor brevis digitorum*.

Some muscular fibres appear to arise from the plantar surface of the recurved os calcis, and to be inserted into the outer side of the tendon of the long flexor of the digits. They may possibly represent the *flexor accessorius*.

Other muscular fibres also arise from the os calcis, and are inserted into the metatarsal bone and proximal phalanx of the fifth digit.

Interossei.—Interosseous muscles are present in the posterior extremity as well as in the anterior one, taking origin from the deep plantar fascia; but they are destitute of the distinct delicate tendons which characterize the interossei of the hand, and have merely an aponeurotic insertion into their respective digits.

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[1] Meckel, *l. c.* p. 29; Owen, *l. c.* p. 382.

On the Serial Homology of the Limbs.

The singular and exceptional conditions presented by certain points in the anatomy of the Echidna suggest considerations tending, perhaps, to throw some additional light on the serial homology of the fore and hind limbs.

This particular question of serial homology has for nearly a century past excited interest and attention. Since 1774 the subject has been more or less noticed or discussed by many, *e. g.* by Vic d'Azyr[1], Winslow[2], Sœmmering[3], Meckel[4], De Blainville[5], Barclay[6], Gerdy[7], Bourgery[8], Dugès[9], F. Blandin[10], Flourens[11], Cruveilhier[12], Auzias Turenne[13], Maclise[14], Owen[15], Ph. Rigaud[16], Paul Gervais[17], Joly and Lavocat[18], Chauveau[19], Ch. Martins[20], Humphry[21], and Huxley[22].

It appears now to be generally admitted that the scapula, humerus, radius, ulna, and pollex are respectively the homotypes, or serial homologues, of the ilium, femur, tibia, fibula, and hallux—with more or less divergence of view, however, as regards the proximal ends of the ulna and tibia and the sesamoids (or sesamoid-like bones), rarely or generally present in the regions of the knee and elbow. The humerus is frequently regarded as a bone twisted more or less on its own axis, so that without an actual or ideal untwisting, its proximal end will not correspond with the similar extremity of its homotype, the femur.

It also appears to be now generally conceded that the extensor surface and muscles of the arm represent the extensor surface and muscles of the leg, and that the same repetition exists, speaking generally, between the flexor surfaces and muscles of the two limbs[1]. It is also, I believe, all but universally received that the costal surface of the scapula, with the subscapular muscle, is represented in the hind limb by the internal surface of the ilium and *iliacus*. Professor Huxley[2] alone, so far as I am aware, has suggested that the last-named muscle is the homotype, or serial homologue, of the *supraspinatus*, comparing the ilium to the remarkable scapula of the Monotremes, in which, as Professor Owen pointed out[3], the apparent anterior costa is really the margin of the spine, and the supraspinatus fossa has come to be placed on the internal or costal surface of the scapula.

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[1] Histoire de l'Académie des Sciences pour l'année 1774.

[2] Exposition Anatomique de la Structure du Corps Humain, nouvelle édition in 12mo, 1775.

[3] De corporis humani fabrica, 1794.

[4] Handbuch der menschlichen Anatomie, 1816.

[5] Nouveau Dictionnaire d'Histoire Naturelle de Deterville, article *Mammifères*, t. xix., 1818.

[6] Explanations of Mitchel's Plates of the Bones, 1824.

[7] Note sur le parallèle des os (Bulletin Universelle de Férussac, Sciences Médicales, t. xvi., 1829).

[8] Traité complet de l'Anatomie de l'Homme, 1832.

[9] Mémoires sur la conformité organique de l'échelle animale, 1832.

[10] Nouveaux éléments d'Anatomie Descriptive, 1838.

[11] Nouvelles observations sur le parellèle des extrémités dans l'homme et les quadrupèdes (Ann. des Sc. Nat. 1838).

[12] Anatomie descriptive, 1843.

[13] Sur les analogies des membres supérieurs avec les inférieurs (Comptes Rendus de l'Acad. des Sc. 1846).

[14] Comparative Osteology and the Archetype Skeleton, 1847; and in Todd's Cyclopædia of Anat. and Physiology, vol. iv. 1852.

[15] Archetype and Homologies of the Vertebrate Skeleton, 1848; and On the Nature of Limbs, 1849.

[16] Sur l'homologie des membres supérieurs et inférieurs de l'homme (Comptes Rendus de l'Acad. des Sc. 1849).

[17] Sur la comparaison des membres chez les animaux vertébrés (Ann. des Sc. Nat. 1853).

[18] Etudes d'anatomie philosophique sur le pied et la main de l'homme (Mémoires de l'Académie de Toulouse, 1853).

[19] Traité d'Anatomie comparée des Animaux Domestiques, 1857.

[20] Nouvelle comparaison des membres pelviens et thoraciques (Ann. des Sc. Nat. 1857); and Ostéologie comparée des articulations du coude et du genou (Mémoires de l'Acad. des Sc. de Montpellier, 1862).

[21] A Treatise on the Human Skeleton, 1858; and a paper entitled "Observations on the Limbs of Vertebrate Animals," 1860, communicated to the Cambridge Philosophical Society.

[22] Hunterian Course of Lectures in 1864, reported in the 'Medical Times' for that year.

Dr. G. M. Humphry, in his 'Treatise on the Human Skeleton,' has made a remarkable advance towards clearing up this serial homology, still retaining, however, interpretations with which I cannot agree. At pages 599 and 600 he says, "The key to the exact homology of the upper and lower LIMBS (figs. 7 and 8), I apprehend, is furnished by the fact that they are placed at opposite ends of the trunk, and that the apposed surfaces of their upper segments have, consequently, been made to correspond with one another. The hæmal constituents of the visceral arches upon which they rest are modified accordingly. Thus the scapula is inclined backwards, and the ilium forwards; the hinder edge of the scapula corresponds with the anterior edge of the ilium; and the rough projection near the glenoid cavity, for the attachment of the long portion of the *triceps* (the extensor of the forearm) corresponds with the anterior inferior spine of the ilium, which gives attachment to the *rectus femoris*, the long portion of the extensor of the leg; the coracoid process is homologous with the pubes, the clavicle with the ischium. The posterior surface of the femur corresponds with the anterior surface of the humerus. The upper flexure in the former bone is backwards, the lower flexure is forwards; whereas in the humerus it is just the reverse. The lesser trochanter of the femur, which receives the *iliacus* muscle coming from the inner surface of the ilium, looks backwards; and the lesser tubercle of the humerus, which receives the *subscapularis* muscle coming from the inner surface of the scapula, looks forwards. The outer and inner surfaces of the two bones respectively correspond with each other: thus the great trochanter of the femur and the great tubercle of the humerus are both directed outwards; the rough space for the great *gluteus*, which comes from the tuber ischii and sacro-sciatic ligament, is upon the outer side of the shaft of the femur; and the rough space for the *deltoid*, which comes from the clavicle and acromium, is upon the outer side of the shaft of the humerus; the rough space for the long adductor muscle, which comes from the spine of the pubis, is on the inner side of the shaft of the femur; and the rough space for the *coraco-brachialis*, which comes from the tip of the coracoid process, is on the inner side of the shaft of the humerus; the outer condyle of the femur corresponds with the capitulum of the humerus; and the inner condyle of the femur corresponds with the trochlear of the humerus."

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[1] Professor Owen does not admit this relationship, but regards the flexors of one limb as the homotypes of the extensors of the other. See the first volume of his recently published Comp. Anat. of Vertebrates, vol. i. p. 221. It is only since my paper was read that I have become aware of this opinion of the learned Professor.

[2] See 'Medical Times' for February 1864.

[3] Todd's Cyclopædia, vol. iii. p. 376.

At page 600 he calls attention to the embryonic condition of the limbs (with their flexor surfaces directed inwards and their extensor surfaces outwards) and the subsequent opposite rotation of their long axes, the last circumstance accounting for the fact that in the adult the posterior surface of the arm corresponds with the anterior surface of the leg.

At page 601 he notices the similarity in position of the palm of the hand and sole of the foot, and accounts for it by the rotation of the distal segment of the anterior limb in an opposite direction to that of its proximal segment.

In his very valuable paper "On the Limbs of Vertebrate Animals," Dr. Humphry maintains substantially the same views, giving examples of the retention throughout life in many lower Vertebrata of the conditions transitorily presented by the limbs of the higher forms. He says, "It has already been remarked that the upper parts of the ilium and the scapula become inclined towards one another during development; and it is probable that they also participate, to some extent, in the rotation which the limbs undergo. That is to say, that at first they are simple, straight, vertically placed elements; and that the corresponding parts, viz. the hinder edge of the scapula and the anterior edge of the ilium, like the surfaces of the limbs of which they are a continuation, are originally directed more or less outwards, and subsequently become turned towards one another. I am not aware that any such change has been actually traced; but it is suggested by an examination of the parts, especially of the scapula, in MONOTREMES, BIRDS, and REPTILES. In the ORNITHORHYNCHUS, more particularly, the hinder edge of the scapula has an inclination outwards, and the spine is turned forwards and forms the anterior margin of the scapula. Such a theory of the rotation of the scapula on its vertical axis accords also with the mode in which, in MAMMALS, the clavicle and acromion usually cross over the coracoid process."

In his tables exhibiting the serial homologies of the bones, ligaments, muscles, arteries, and nerves of the limbs, the spine and acromion of the scapula are represented, at page 35, as corresponding with the ridge for the *gluteus maximus* continued into the sacro-sciatic ligament, the subacromial notch with the sacro-sciatic notch, the great tubercle of the humerus with the great trochanter of the femur, and the small tubercle of the humerus with the small trochanter of the femur. At page 37 it is stated that the *subscapularis* represents the *iliacus internus*, and that the *latissimus dorsi* may represent the *psoas magnus*. Dr. Humphry, at page 22, also argues against the theory of the "torsion of the humerus" (supported by M. Charles Martins and others), yet, at page 35, he represents the outer condyle of the humerus as answering to the inner condyle of the femur, and *vice versâ*.

Professor Huxley, in his Hunterian Course[1] of Lectures for the year 1864, after recapitulating the principal conclusions arrived at by his predecessors, states that none of them can be considered thoroughly satisfactory, and that even what he himself proposes cannot be so considered, on account of its not having been checked by a study of the development of the parts concerned. He calls attention to the embryonic condition of the limbs, before alluded to, adding (as reported) that "that embryonic condition continues throughout life in many Amphibia and Reptiles, and without much change in *Galeopithecus* among Mammals." He then makes the comparisons before mentioned between the scapula and ilium, grounding his determinations on the conditions presented by the Ornithorhynchus.

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[1] Reported in the 'Medical Times' for 1864, see p. 203.

The Echidna, however, presents certain differences from the Ornithorhynchus, as may already have been gathered from the first part of this paper. In the Echidna, as in the Ornithorhynchus, the apparent anterior costa of the scapula is really the edge of its spine and acromion, the supraspinatus fossa is on the internal costal surface of the bone, and the infraspinatus fossa is immediately behind its actual anterior margin. But while in the Ornithorhynchus the *subscapularis* occupies that part of the internal or costal surface of the scapula which is not occupied by the *supraspinatus*, in the Echidna, on the other hand, the *subscapularis* occupies exclusively the external surface of the scapula.

The true nature of these muscles is determined by their insertions—the *supraspinatus* being inserted, in common with the *infraspinatus*, into the greater or radial tuberosity; while the *subscapularis* is inserted into the lesser or ulnar [1] one, somewhat above the insertion of the *teres major*.

Such being the condition of the anterior limb, we find, when we turn to the pelvic region and thigh, a certain unmistakeable resemblance between the muscles inserted into the lesser tuberosity and those implanted into the greater trochanter, *i. e.* between what I have called the *gluteus minimus* (but which may be the *gluteus medius*) and the *subscapularis*, and between what I have called the *gluteus medius* (but which may be a deeper portion of the *gluteus maximus*) and the *teres major*.

Moreover, when we observe the peculiar position of the scapula in the Echidna, it is, I think, almost impossible to avoid being struck with the correspondence in this animal of the outer (in it subscapular) surface of the scapula with the outer (gluteal) surface of the ilium, and being tempted once more to reconsider the serial homologies of the parts connected with the proximal ends of the humerus and femur respectively.

Accepting, as satisfactorily demonstrated, the correspondence between the extensor surfaces of the fore and hind limbs, and recognizing that these extremities are placed in an essentially similar position when the radius and pollex, the tibia and hallux are all turned forwards, while the palm and sole, with the flexor surfaces of the limbs, are all directed inwards, we yet find certain discrepancies, one being that the articular head of the humerus is turned backwards, while that of the femur looks, and is prolonged, in a forward direction.

It is mainly, perhaps, this fact which has occasioned so many laboured, and more or less ingenious, endeavours at explanation, by suggestions that the right fore limb answers to the left hind limb and *vice versâ*, or that a greater or less rotation of the upper part of the humerus upon the lower has taken place. But this discrepancy is much less marked in some animals than in others; for example, it is less so in *Cholœpus* than in the majority of mammals; in *Pteropus* it is still less in degree, while in some Reptilia it disappears altogether, the humerus not only resembling the femur in size and shape, but also in the aspect of its proximal articular surface. This is particularly well seen in Chelonians[1], in which the correspondence between the humerus and femur for the whole length of each is at once evident without the necessity of any real or imaginary rotation of either bone.

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[1] Since my paper was read, I find that Professor Owen has anticipated me in this term. In the first volume of his 'Comparative Anatomy and Physiology of Vertebrates' (just published), at page 176, he speaks of "the inner (ulnar) tuberosity."

Putting aside, then, the objections that may be founded on the opposed direction of the proximal articular surfaces of the humerus and femur, it is evident that if the correspondence between the extensor surfaces of those two bones extends to their summits, the anterior and posterior borders of the proximal, as well as of the distal, parts of one must be serially related to the anterior and posterior borders of the proximal, as well as distal, parts of the other. Now when the limbs are placed with their flexor surfaces inwards, and the pollex and hallux, radius and tibia forwards, we find, in the humerus, two prominences (the two tuberosities), one on the radial side of the bone and projecting more or less forwards, the other towards its ulnar side and projecting more or less backwards. Similarly in the femur there are two prominences (the two trochanters), one towards the tibial side of the bone and projecting more or less forwards, the other on its peroneal side and projecting more or less backwards. In fact it becomes evident that the radial (or greater) tuberosity is the homotype of the tibial (or smaller) trochanter, and, on the other hand, that the ulnar (or lesser) tuberosity is the homotype of the peroneal (or greater) trochanter[2].

This relation is disguised in Man and in many animals by the fact that in the fore limb the radial tuberosity is large and the ulnar one small, while in the hind limb the reverse condition obtains between the trochanters, the tibial one being so much the smaller. This decrepancy, however, is not constant. Thus in *Galeopithecus* the ulnar (or lesser) tuberosity very much resembles, both in size and shape, the peroneal (or greater) trochanter. In *Cholœpus*[3] the peroneal (or lesser) trochanter is relatively as large as the radial (or greater) tuberosity, which is not more, perhaps even less, developed than is the ulnar (or lesser) tuberosity.

In *Bradypus*[4], also, the ulnar (or lesser) tuberosity is decidedly larger than the radial (or greater) one.

In *Pteropus*, at least in some species, the condition existing in Man and most vertebrates is completely inverted, the ulnar (or lesser) tuberosity and the tibial (or lesser) trochanter being more developed than are the radial tuberosity and peroneal trochanter respectively.

In Birds the true serial relations seem, at first sight, to be somewhat obscured by the persistent non-development of the tibial (lesser) trochanter; but these animals present us with another homological indication in the position of the pneumatic foramen, which, in the leg opens upon the extensor surface of the single and peroneal (greater) trochanter; while in the wing the corresponding opening is, indeed, situated on the extensor surface, but on that of the ulnar (or lesser) tuberosity, and not upon the radial (or greater) one.

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[1] See the fine skeleton of *Chelydra Temminckii* lately added to the Museum of the Royal College of Surgeons.

[2] Since this paper was read, I have learned from Professor Huxley that, in 1864, he enunciated at the College of Surgeons this inverse relation of the tuberosities and trochanters; but the fact not being recorded in the only report extant of the Hunterian Lectures for that year (at only the last three of which I was present), I had no means whatever of becoming acquainted with a fact which had even for a time escaped his memory.

[3] See no. 2387 *a* in the Collection of the Royal College of Surgeons.

[4] See no. 2367 in the same Collection.

In some reptiles, *e. g.* in the Chelonions[1], as before observed, the most complete and striking similarity exists between the humerus and the femur, and between their respective tuberosities and trochanters; while in other reptilian forms great differences present themselves in regard to the size and development of the several prominences.

If, as I believe, there is this relation of serial homology between the tuberosities and trochanters, then there is a *primâ facie* probability that a similar relation will be found to exist between the muscles respectively inserted into those processes, the more important relation of a muscle being, generally, its insertion. We may then expect to find that the *supra-* and *infraspinatus*, with the *teres minor* (all inserted into the radial tuberosity), correspond with the *iliacus* and *psoas* (inserted into the tibial trochanter), and that the *subscapularis* and *teres major* (attached to the ulnar tuberosity) answer to the muscles inserted into the peroneal trochanter, *i. e.* to the *glutei.*

Now this latter resemblance *is* exactly what exists in the Echidna; and it would be highly interesting to know whether this similarity is also present in the muscular structure of Reptiles and Amphibians.

Should it turn out to be the case that the true muscular relations are such as I have suggested, it would probably go far to settle the interesting question as to what parts of the ilium really answer to the several parts of the scapula.

In the skeleton of an ordinary quadruped (or in that of Man when put in a corresponding attitude), in order to place the humerus and femur in the proper position to exhibit their serial homologies (with both extensor surfaces outwards), the elbow must be drawn outwards and forwards, and the knee outwards and backwards; but one is tempted to ask (as has already been done by Dr. Humphry in the passage above quoted), why should not the bones from which the humerus and femur are suspended participate in the rotation? If they *are* made to do so (and in *Galeopithecus*[2] they are naturally somewhat in this rotated position), we then get the axillary margin and point of attachment of the *triceps* in the scapula, and the anterior border and point of attachment of the *rectus femoris* in the ilium, both turned outwards, while the subscapular fossa of the scapula and the outer surface of the ilium both look backwards, and the *supra-* and *infraspinatus* fossæ and the inner surface of the ilium are both forwardly directed.

In this position (when the human scapula and ilium are compared) the coracoid seems to answer to what I believe to be its *true* homotype, the ischium, in its relation to the articular cavity and to the bone generally (both coracoid and ischium being *posterior* in position) also the suprascapular notch seems to repeat the sacro-sciatic one, while the spine of the ischium, with the lesser sacro-sciatic ligament attached to it, recalls to mind the prominence from the base of the coracoid with its coracoid ligament, which prominence becomes so much developed in certain mammals.

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[1] See, e. g., *Trionyx* in the British Museum, and *Chelydra Temminckii* in the Museum of the Royal College of Surgeons.

[2] See the skeleton, no. 4630 *c*, in the Museum of the Royal College of Surgeons. Mr. W. H. Flower kindly directed my attention to this skeleton.

As to the spine and acromium of the scapula, there appears, on this view, to be nothing to represent them in the ilium, unless it might be the ilio-pectineal line and eminence, though the latter seems to be rather a development from the pubis than from the ilium. These osteological resemblances between the scapula and ilium I mention only as suggestions, being myself as yet far from convinced of their validity.

Dr. Humphry and, long before him, Vicq d'Azyr have both recognized the correspondence between the anterior border of the ilium and the axillary margin of the scapula; they both, however, take for granted that the subscapular fossa answers to the iliac one.

Now, in the Echidna as has been said, the surface of the scapula which gives origin to the *subscapularis* looks backwards and outwards. Are we, then, to regard the scapula in that animal as being, so to speak, in a more normal and natural position than that of most mammals, or, on the other hand, as being modified in a special and peculiar manner? Possibly the latter. For, in fact, the scapula is in that animal so formed that the middle of its outer surface (the point of origin of the *triceps*) might be considered to correspond to the axillary margin of the scapula of an ordinary mammal, and the anterior margin (superior costa of Man) to represent almost, if not quite, the actual posterior margin of the scapula of the Echidna.

In the Ornithorhynchus the conditions are somewhat different; for though the scapula is turned forwards, yet part of the *subscapularis* occupies a portion of the inner or costal surface of the scapula, while the *supraspinatus* muscle seems to be of much less extent.

On the whole, I am inclined to believe that extended investigations will show that the scapula and ilium may most conveniently be regarded as, so to speak, essentially columnar bones, such as we find them in Chelonians, and serving to give origin to muscles inserted into the proximal bone of each limb, but varying in shape and size, and developing ridges or processes according to the exigencies of each case[1]. In most mammals a large lamella of bone is shot out between the *supra-* and *infraspinatus*, another between the *supraspinatus* and *subscapularis*, and another, still larger one between the last-mentioned muscle and the *infraspinatus*.

In the Ornithorhnychus we might consider the plate between the *infraspinatus* and the *subscapularis* to be suppressed, and that between the *supraspinatus* and the *subscapularis* to be almost so. On the other hand, that there is a plate developed opposite to that separating the *supra-* from the *infraspinatus* muscle, which, as it were, passes into the midst of the *subscapularis*, throwing the posterior part of it to the outside and on to the same surface as that occupied by the *infraspinatus*, while the rest of it is but very slightly separated from the *supraspinatus*.

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[1] I am very happy to be able to add that my friend Mr. W. K. Parker has informed me that he has independently arrived at a similar conclusion, having been led to it by his osteological investigations.

The condition presented in the Echidna might be represented by a further modification. In that animal I find no trace of a ridge on the inside of the scapula like that which, in the Ornithorhynchus [1], separates the *supraspinatus* from the *subscapularis*; but the *supraspinatus* is, nevertheless, separated from the *subscapularis* by a very large lamella, which throws the last-mentioned muscle entirely to the outer side of the scapula, and is the only one developed except that separating the *supra-* from the *infra-spinatus*.

The foregoing considerations suggest themselves from an examination of this most interesting mammal; but I am far from supposing that what has been here stated is sufficient to establish the myological homologies above suggested, which would require a fresh and careful study of all the main conditions presented by the limbs of the Vertebrata, especially of Reptiles and Amphibians, for their satisfactory demonstration. I cannot but think, however, that some cause has been shown for the promulgation of the hypothesis, and possibly enough to warrant further inquiries respecting this long-debated and interesting question of serial homology.

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[1] Professor Owen says, "In the Echidna this ridge is nearly obsolete," Todd's 'Cyclopædia,' vol. iii. p. 376.

EXPLANATION OF THE PLATES.

Plate LII. Muscles of fore limb of *Echidna hystrix*.

Fig. 1. Outer surface of left fore limb.
TZ. Trapezius.
L.D^{1}. Latissimus dorsi (posterior portion).
L.D^{2}. Latissimus dorsi (anterior portion).
D.E. Dorso-epitrochlear.
S.M. Serratus magnus.
T.M. Teres major.
S. Subscapularis.
I.S. Infraspinatus.
D^{2}. Deltoid (second portion).
T. Triceps.
E.R.L. Extensor radialis longior.
E.R.B. Extensor radialis brevior.
E.M.P. Extensor ossis metacarpi pollicis.
E.C. Extensor communis digitorum.
E.M.D. Extensor minimi digiti.
E.U. Extensor carpi ulnaris.
F.U. Flexor carpi ulnaris.
P.C. Panniculus carnosus.

Fig. 2. Front view of left shoulder and arm.
S.M. Sterno-mastoid.
R. Rectus abdominis.
P. Pectoralis.
E.H. Epicoraco-humeral.
D^{1}. Deltoid (first portion).
D^{2}. Deltoid (second portion).
S.S. Supraspinatus.
I.S. Infraspinatus.
C.B. Coraco-brachialis.
B. Biceps.
E.C. Extensor communis digitorum.
E.M.P. Extensor ossis metacarpi pollicis.
E.R.L. Extensor carpi radialis longior.
E.R.B. Extensor carpi radialis brevior.
P.T. Pronator teres.
F.R. Flexor carpi radialis.
F.U. Flexor carpi ulnaris.

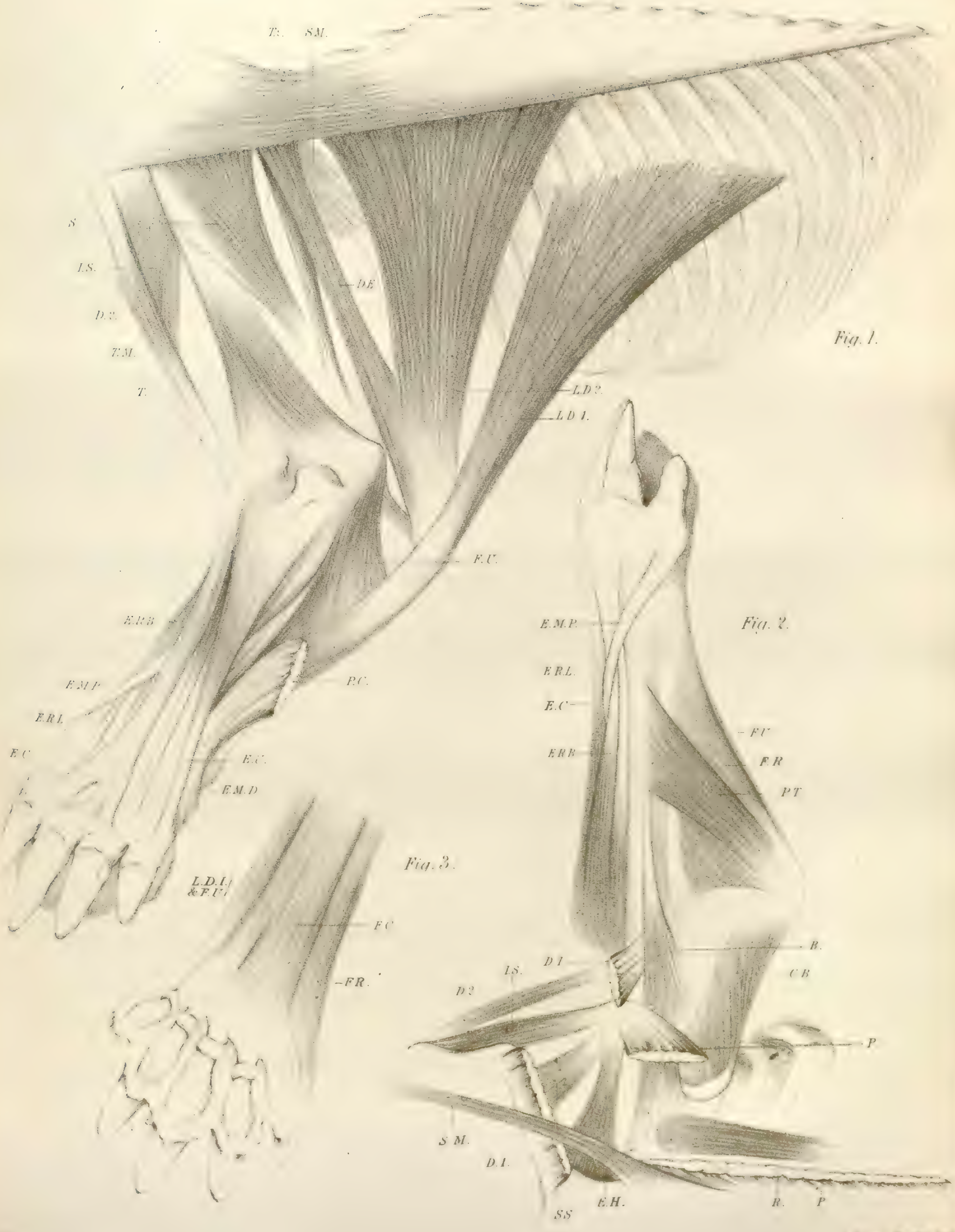
Fig. 3. Flexor surface of left forearm and hand.
F.C. Flexor communis digitorum.
F.R. Flexor carpi radialis.
L.D^{1}. & F.U. Conjoined posterior part of Latissimus dorsi and Flexor carpi ulnaris.

PLATE LIII. Muscles of the posterior limb of *Echidna hystrix*.

Fig. 1. Inner surface of posterior limb.
PS.P. Psoas parvus.
I. Iliacus.
S. Sartorius.
P. Pectineus.
R. Rectus femoris.
V.I. Vastus internus.
A.B. Adductor brevis.
A.M. Adductor magnus.
G. Gracilis.
S.M. Semimembranosus.
S.T. Semitendinosus.
B. Biceps.
G.MX. Gluteus maximus.
T.A^{1}. Tibialis anticus (inner portion).
PLA. Plantaris.
T.P. Tibialis posticus.
G.O. Gastrocnemius.
SO. Soleus.
FL.D. Flexor longus digitorum.

Fig. 2. Outer surface of posterior limb.
G.MX. Gluteus maximus.
G.MD. Gluteus medius.
G.MI. Gluteus minimus.
PY. Pyriformis, with the great sciatic nerve passing over it.
R. Rectus femoris.
V.E. Vastus externus.
B. Biceps.
T.A^{1}. Tibialis anticus (inner portion).
T.A^{2}. Tibialis anticus (outer portion).
E.L.H. Extensor longus hallucis.
E.L.D. Extensor longus digitorum.

Fig. 3. Deeper muscles of outer side of posterior limb.
T.A^{1}. Tibialis anticus (inner portion).
T.A^{2}. Tibialis anticus (outer portion).
E.L.H. Extensor longus hallucis.
E.L.D. Extensor longus digitorum.
P.L. Peronæus longus.
B. Biceps.


Tr. SM.
S
I.S.
D.2.
T.M.
T.
DE
L.D 2.
L.D 1.
F.U.
E.R.B
E.M.P
P.C.
E.R.L
E.C
E.U.
E.M.D
Fig. 1.
Fig. 2.
E.M.P.
E.R.L.
E.C
F.U
E.R.B
F.R
P.T
B.
C.B
D.1
I.S.
D.2
P
S.M.
D.1.
S.S
E.H.
R.
P
Fig. 3.
L.D.1.
& F.U.
F.C
F.R.

Wesley, ad nat. del et lith.

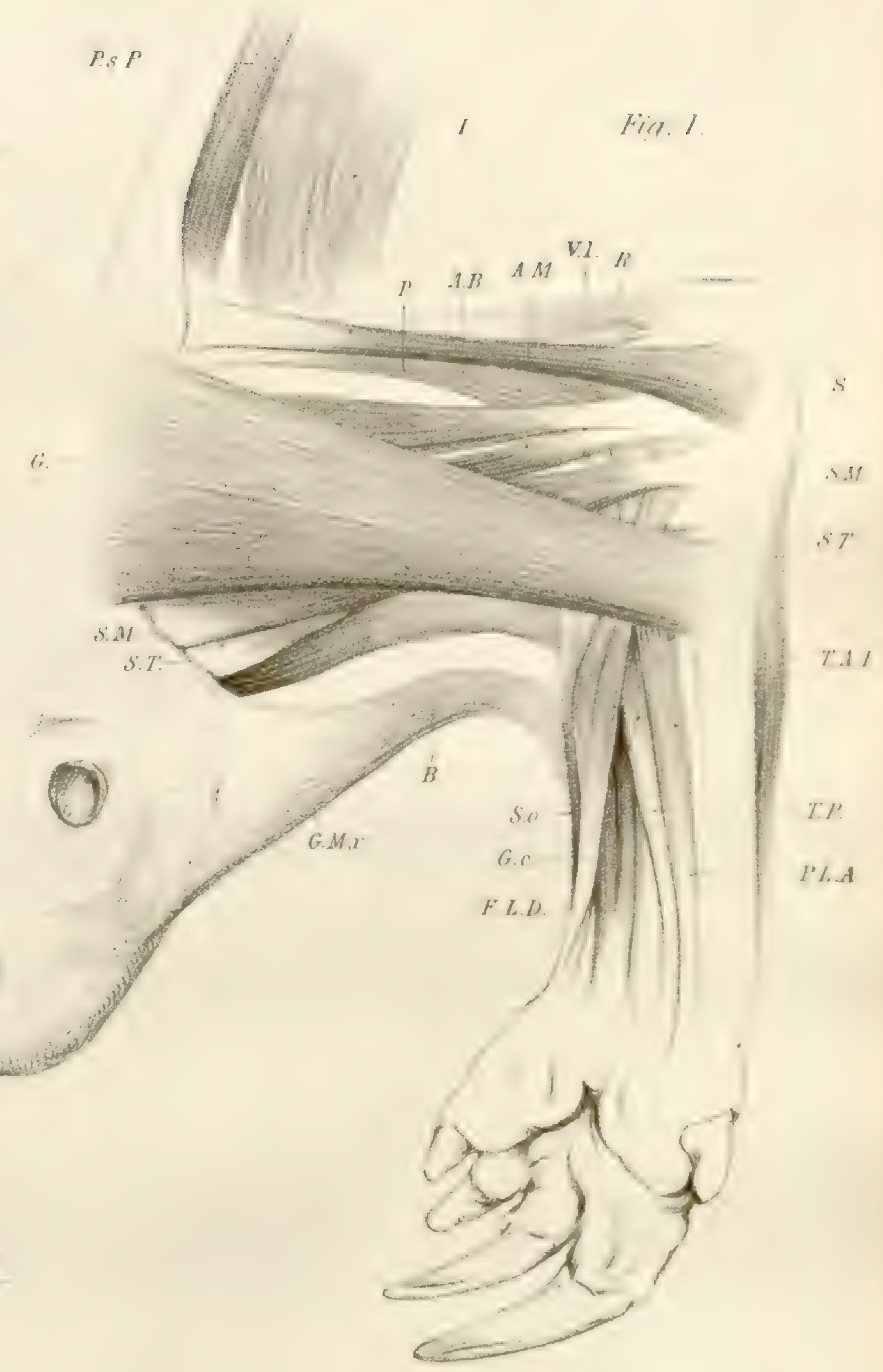


Fig. 1.
P.s P
I
P
A.B
A.M
V.I.
R
S
S.M
S.T
G.
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T.A.1
B
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F.L.D.
G.Mx
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P.L.A

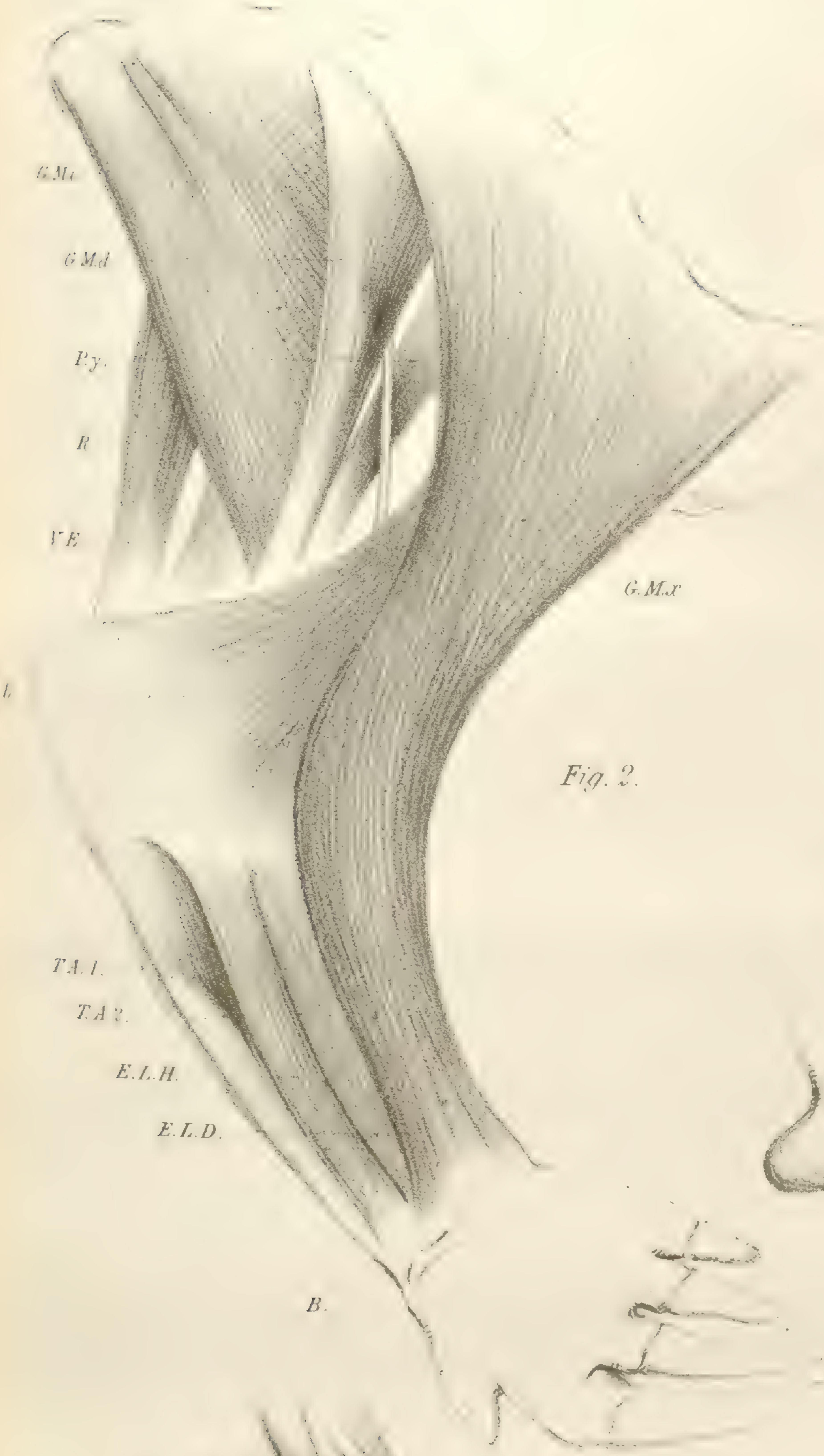
Fig. 2.
G.Mi
G.Md
Py.
R
V.E
I
G.Mx
T.A.1.
T.A.2.
E.L.H.
E.L.D.
B.

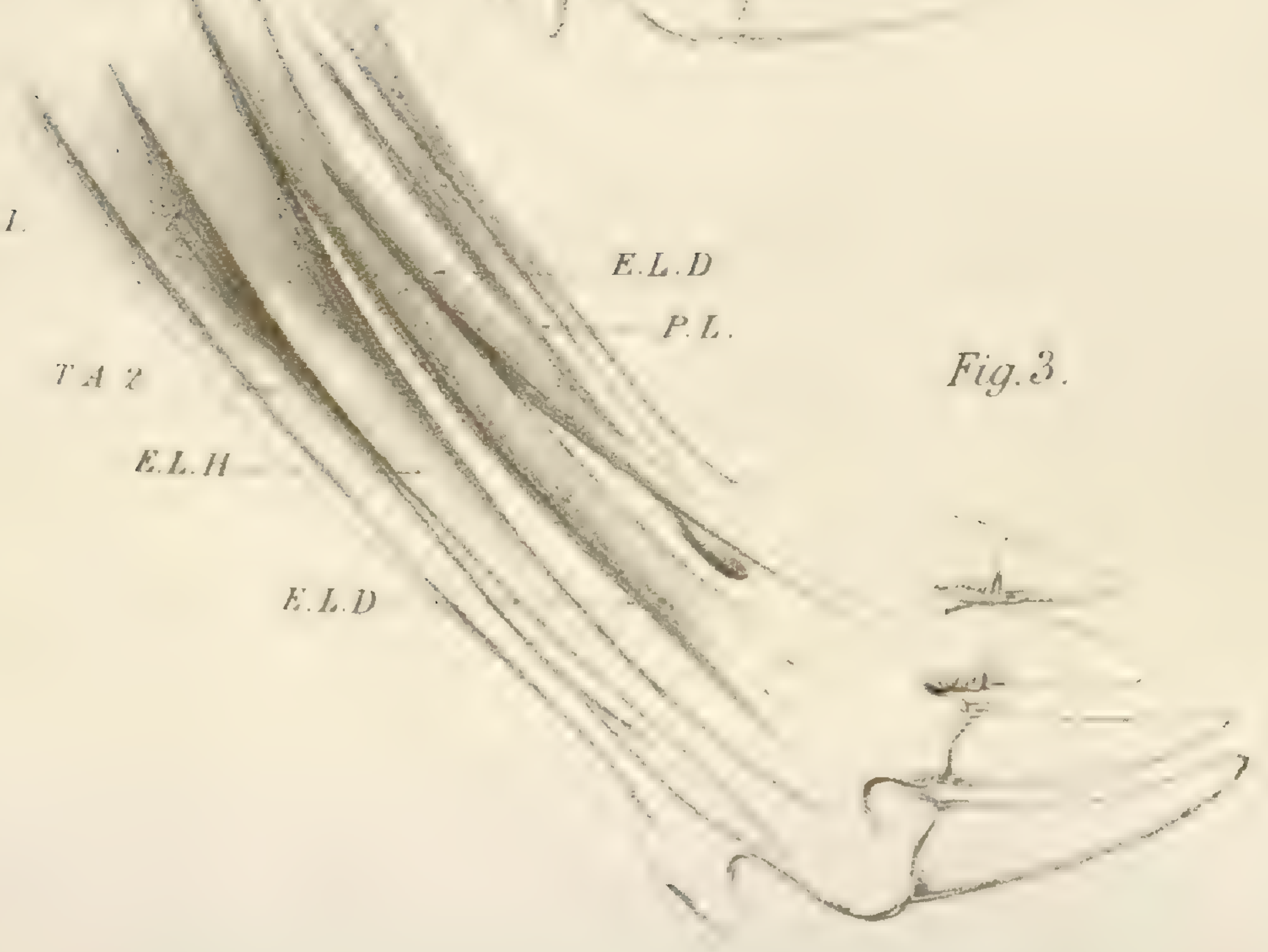
Fig. 3.
T.A.1.
E.L.D
P.L.
T.A.2.
E.L.H.
E.L.D

Wesley, ad nat. del. et lith.

[illegible] imp.

XV. *On Circulation and the Formation of Wood in Plants.* *By* HERBERT SPENCER, *Esq.* *Communicated by* GEORGE BUSK, *Esq.*, *F.R.S.*, *Sec. L.S.*

(Plate LIV.)

Read March 1st, 1866.

OPINIONS respecting the functions of the vascular tissues in plants appear to make but little progress towards agreement. The supposition that these vessels and strings of partially-united cells, lined with spiral, annular, reticulated, or other frameworks, are carriers of the plant-juices, is objected to on the ground that they often contain air: as the presence of air arrests the movement of blood through arteries and veins, its presence in the ducts of stems and petioles is assumed to unfit them as channels for sap. On the other hand, that these structures have a respiratory office, as some have thought, is certainly not more tenable, since, if the presence of air in them negatives the belief that their function is to distribute liquid, the presence of liquid in them equally negatives the belief that their function is to distribute air. Nor can any better defence be made for the hypothesis which I find propounded, that these parts serve "to give strength to the parenchyma." Tubes with fenestrated and reticulated internal skeletons have, indeed, some power of supporting the tissue through which they pass; but tubes lined with spiral threads can yield extremely little support, while tubes lined with annuli, or spirals alternating with annuli, can yield no support whatever. Though all these types of internal framework are more or less efficient for preventing closure by lateral pressure, they are some of them quite useless for holding up the mass through which the vessels pass; and the best of them are for this purpose mechanically inferior to the simple cylinder. The same quantity of matter made into a continuous tube would be more effective in giving stiffness to the cellular tissue around it.

In the absence of any feasible alternative, the hypothesis that these vessels are distributors of sap claims reconsideration. The objections are not, I think, so serious as they seem. The habitual presence of air in the ducts that traverse wood, can scarcely be held anomalous if when the wood is formed their function ceases. The canals which ramify through a Stag's horn, contain air after the Stag's horn is fully developed; but it is not thereby rendered doubtful whether it is the function of arteries to convey blood. Again, that air should frequently be found even in the vessels of petioles and leaves, will not appear remarkable when we call to mind the conditions to which a leaf is subject. Evaporation is going on from it. The thinner liquids pass by osmose out of the vessels into the tissues containing the liquids thickened by evaporation. And as the vessels are thus continually drained, a draught is made upon the liquid contained in the stem and roots. Suppose that this draught is unusually great, or suppose that around the roots there exists no adequate supply of moisture. A state of capillary tension must result—a tendency of the liquid to pass into the leaves, resisted below by liquid cohesion. Now, had the vessels impermeable coats, only their upper extremities would under these conditions be slowly emptied. But their coats, in common with all the surrounding tissues, are permeable by air. Hence, under this state of capillary tension, air will enter; and as the upper ends of the tubes, being both smaller in diameter and less porous than the lower, will retain the liquids with greater tenacity, the air will enter the wider and more porous tubes below—the ducts of the stem and branches. Thus the entrance of air no more proves that these ducts are not sap-carriers, than does the emptiness of tropical river-beds in the dry season prove that they are not channels for water. There is, however, a difficulty which seems more serious. It is said that air, when present in these minute canals, must be a great obstacle to the movement of sap through them. The investigations of Jamin have shown that bubbles in a capillary tube resist the passage of liquid, and that their resistance becomes very great when the bubbles are numerous—reaching, in some experiments, as much as three atmospheres. Nevertheless the inference that any such resistance is offered by the air-bubbles in the vessels of a plant, is, I think, an erroneous one. What happens in a capillary tube having impervious sides, with which these experiments were made, will by no means happen in a capillary tube having pervious sides. Any pressure brought to bear on the column of liquid contained in the porous duct of a plant, must quickly cause the expulsion of a contained air-bubble through the minute openings in the coats of the duct. The greater molecular mobility of gases than liquids, implies that air will pass out far more readily than sap. Whilst, therefore, a slight tension on the column of sap will cause it to part and the air to enter, a slight pressure upon it will force out the air and reunite the divided parts of the column.

To obtain data for an opinion on this vexed question, I have lately been experimenting on the absorption of dyes by plants. So far as I can learn, experiments of this kind have most, if not all of them, been made on stems, and, as it would seem from the results, on stems so far developed as to contain all their characteristic structures. The first experiments I made myself were on such parts, and yielded evidence that served but little to elucidate matters. It was only after trying like experiments with leaves of different ages and different characters, and with undeveloped axes, as well as with axes of special kinds, that comprehensible results were reached; and it then became manifest that the appearances presented by ordinary stems when thus tested, are in a great degree misleading. Let me briefly indicate the differences.

If an adult shoot of a tree or shrub be cut off, and have its lower end placed in an alumed decoction of logwood or a dilute solution of magenta *, the dye will, in the course of a few hours, ascend to a distance varying according to the rate of evaporation from the leaves.

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* These two dyes have affinities for different components of the tissues, and may be advantageously used in different cases. Magenta is rapidly taken up by woody matter and other secondary deposits; while logwood colours the cell-membranes, and takes but reluctantly to the substances seized by magenta. By trying both of them on the same structure, we may guard ourselves against any error arising from selective combination.

On making longitudinal sections of the part traversed by it, the dye is found to have penetrated extensive tracts of the woody tissue; and on making transverse sections, the openings of the ducts appear as empty spaces in the midst of a deeply-coloured prosenchyma. It would thus seem that the liquid is carried up the denser parts of the vascular bundles: neglecting the cambium layer, neglecting the central pith, and neglecting the spiral vessels of the medullary sheath. Apparently the substance of the wood has afforded the readiest channel. When, however, we examine these appearances critically, we find reasons for doubting this conclusion. If a transverse section of the lower part, into which the dye passed first and has remained longest, be compared with a transverse section of the part which the dye has but just reached, a marked difference is visible. In the one case the whole of the dense tissue is stained; in the other case it is not. This uneven distribution of stain in the part which the dye has incompletely permeated is not at random; it admits of definite description. A tolerably regular continuous ring of colour distinguishes the outer part of the wood from the inner mass, implying a passage of liquid up the elongated cells next the cambium layer. And the inner mass is coloured more round the mouths of the pitted ducts than elsewhere: the dense tissue is darkest close to the edges of these ducts; the colour fades away gradually on receding from their edges; there is most colour where there are several ducts together; and the dense tissue which is fully dyed for some space, is that which lies between two or more ducts. These are indications that while the layer of pitted cells next the cambium has served as a channel for part of the liquid, the rest has ascended the pitted ducts, and oozed out of these into the prosenchyma around. And this conclusion is confirmed by the contrast between the appearances of the lowest part of a shoot under different conditions. For if, instead of allowing the dye time for oozing through the prosenchyma, the end of the shoot be just dipped into the dye and taken out again, we find, on making transverse sections of the part into which the dye has been rapidly taken up, that, though it has diffused to some distance round the ducts, it has left tracts of wood between the ducts uncoloured—a difference which would not exist had the ascent been through the substance of the wood. Even still stronger is the confirmation obtained by using one dye after another. If a shoot that has absorbed magenta for an hour be placed for five minutes in the logwood decoction, transverse sections of it taken at a short distance from its end show the mouths of the ducts surrounded by dark stains in the midst of the much wider red stains.

Based on these comparisons only, the inference pointed out has little weight; but its weight is increased by the results of experiments on quite young shoots, and shoots that develope very little wood. The behaviour of these corresponds perfectly with the expectation that a liquid will ascend capillary tubes in preference to simple cellular tissue or tissue not differentiated into continuous canals. The vascular bundles of the medullary sheath are here the only channels which the coloured liquid takes. In sections of the parts up to which the dye has but just reached, the spiral, fenestrated, scalariform, or other vessels contained in these bundles are alone coloured; and lower down it is only after some hours that such an exudation of dye takes place as suffices partially to colour the other substances of the bundle. Further, it is to be noted that at the terminations of shoots, where the vessels are but incompletely formed out of irregularly joined fibrous cells which still retain their original shapes, the dye runs up the incipient vessels and does not colour in the smallest degree the surrounding tissue.

Experiments with leaves bring out parallel facts. On placing in a dye a petiole of an adult leaf of a tree, and putting it before the fire to accelerate evaporation, the dye will be found to ascend the midrib and veins at various rates, up even to a foot per hour. At first it is confined to the vessels; but by the time it has reached the point of the leaf, it will commonly be seen that at the lower part it has diffused itself into the sheaths of the vessels. In a quite young leaf from the same shoot, we find a much more rigorous restriction of the dye to the vessels. On making oblique sections of its petiole, midrib, and veins, the vessels have the appearance of groups of sharply defined coloured rods imbedded in the green prosenchyma; and this marked contrast continues with scarcely an appreciable change after plenty of time has been allowed for exudation.

The facts thus grouped and thus contrasted seem, at first sight, to imply that while they are young the coats of these ramifying canals lined with spiral or allied structures are not readily permeable, but that becoming porous as they grow old they allow the liquids they carry to escape with increasing facility; and hence a possible interpretation of the fact that, in the older parts, the staining of the tissue around the vessels is so rapid as to suggest that the dye has ascended directly through this tissue, whereas in the younger parts the reverse appearance necessitates the reverse conclusion. But now, is this difference determined by difference of age, or is it otherwise determined? The evidence as presented in ordinary stems and leaves shows us that the parts of the vascular system at which there is a rapid escape of dye are not simply older parts, but are parts where a deposit of woody matter is taking place. Is it, then, that the increasing permeability of the ducts, instead of being directly associated with their increasing age, is directly associated with the increasing deposit of dense substance around them?

To get proof that this last connexion is the true one, we have but to take a class of cases in which wood is formed only to a small extent. In such cases experiments show us a far more general and continued limitation of the dye to the vessels. Ordinary herbs and vegetables, when contrasted with shrubs and trees, illustrate this; as instance the petioles of Celery, or of the common Dock, and the leaves of Cabbages or Turnips. And then in very succulent plants, such as *Bryophyllum calycinum*, *Kalanchoë rotundifolia*, the various species of *Crassula*, *Cotyledon*, *Kleinia*, and others of like habit, the ducts of old and young leaves alike retain the dye very persistently, the concomitant in these cases being the small amount of prosenchyma around the ducts, or the small amount of deposit in it, or both. More conclusive yet is the evidence which meets us when we turn from very succulent leaves to very succulent axes. The tender young shoots of *Kleinia ante-euphorbium*, or *Euphorbia Mauritanica*, which for many inches of their lengths have scarcely any ligneous fibres, show us scarcely any escape of the coloured liquid from the vessels of the medullary sheath. So, too, is it with *Stapelia Buffonia*, a plant of another order, having soft swollen axes. And then we have a repetition of the like connexion of facts throughout the *Cactaceæ*, the most succulent showing us the smallest permeability of the vessels. In two species of *Rhipsalis*, in two species of

Cereus, and in two species of *Mammillaria*, which I have tried, I have found this so. *Mammillaria gracilis* may be named as exemplifying the relation under its extreme form. Into one of these small spheroidal masses, the dye ascends through the large bundles of spiral or annular ducts, or cells partially united into such ducts, colouring them deeply, and leaving the feebly marked sheath of prosenchyma, together with the surrounding watery cellular tissue, perfectly uncoloured.

The most conclusive evidence, however, is furnished by those *Cactaceæ* in which the transition from succulent to dense tissue takes place variably, according as local circumstances determine. *Opuntia* yields good examples. If a piece of it including one of the joints at which wood is beginning to form be allowed to absorb a coloured liquid, the liquid, running up the irregular bundles of vessels and into many of their minute ramifications, is restricted to these where they pass through the parenchyma forming the mass of the stem, but near the joints the hardened tissue around the vessels is coloured. In one of these fleshy growths we get clear evidence that the escape of the dye has no immediate dependence on the age of the vessels, since, in parts of the stem that are alike in age, some of the vessels retain their contents while others do not. Nay, we even find that the younger vessels are more pervious than the older ones, if round the younger ones there is a formation of wood.

Thus, then, is confirmed the inference before drawn, that in ordinary stems the staining of the wood by an ascending coloured liquid is due, not to the passage of the coloured liquid up the substance of the wood, but to the permeability of its ducts and such of its pitted cells as are united into irregular canals. And the facts showing this, at the same indicate with tolerable clearness the process by which wood is formed. What in these cases is seen to take place with a dye, may be fairly presumed to take place with sap. Where the dye exudes but slowly, we may infer that the sap exudes but slowly; and it is a fair inference that where the dye leaks rapidly out of the vessels, the sap does the same. Inferring, thus, that wherever there is a considerable formation of wood there is a considerable escape of the sap, we see in the one the result of the other. The thickening of the prosenchyma is proportionate to the quantity of nutritive liquid passing into it; and this nutritive liquid passes into it from the vessels, ducts, and irregular canals it surrounds.

But an objection is made to such experiments as the foregoing, and to all the inferences drawn from them. It is said that portions of plants cut off and thus treated, have their physiological actions arrested, or so changed as may render the results misleading; and it is said that when detached shoots and leaves have their cut ends placed in solutions, the open mouths of their vessels and ducts are directly presented with the liquids to be absorbed, which does not happen in their natural states. Further, making these objections look serious, it is alleged that when solutions are absorbed through the roots, quite different results are obtained: the absorbed matters are found in the tissues and not in the vessels. Clearly, were the experiments yielding these adverse results conducted in unobjectionable ways, the conclusion implied by them would negative the conclusions above drawn. But these experiments are no less objectionable than those to which they are opposed. Such mineral matters as salts of iron, solutions of which have in some cases been supplied to the roots for their absorption, are obviously so unlike the matters ordinarily absorbed that they are likely to interfere fatally with the physiological actions. If experiments of this kind are made by immersing the roots in a dye, there is, besides the difficulty that the mineral mordant contained by the dye is injurious to the plant, the further difficulty that the colouring-matter, being seized by the substances for which it has an affinity, is left behind in the first layers of root-tissues passed through, and that the decolorized water passing up into the plant is not traceable. To be conclusive, then, an experiment on absorption through roots must be made with some solution which will not seriously interfere with the plant's vital processes, and which will not have its distinctive element left behind. To fulfil these requirements I adopted the following method. Having imbedded a well-soaked broad bean in moist sand, contained in an inverted cone of card-board with its apex cut off for the radicle to come through—having placed this in a wide-mouthed dwarf bottle, partly filled with water, so that the protruding radicle dipped into the water—and having waited until the young bean had a shoot some three or more inches high, and a cluster of secondary rootlets from an inch to an inch and a half long—I supplied for its absorption a simple decoction of logwood, which, being a vegetal matter, was not likely to do it much harm, and which, being without a mordant, would not leave its suspended colour in the first tissues passed through. To avoid any possible injury, I did not remove the plant from the bottle, but, slightly raising the cone out of its neck, I poured away the water through the crevice and then poured in the logwood decoction; so that there could have been no broken end or abraded surface of a rootlet through which the decoction might enter. Being prepared with some chloride of tin as a mordant, I cut off, after some three hours, one of the lowest leaves, expecting that the application of the mordant to the cut surface would bring out the characteristic colour if the logwood decoction had risen to that height. I got no reaction, however. But after eight hours I found, on cutting off another leaf, that the vessels of its petiole were made visible as dark streaks by the colour with which they were charged—a colour differing, as was to be expected, from that of the logwood decoction, which spontaneously changes even by simple exposure. It was then too late in the day to pursue the observations; but next morning the vessels of the whole plant, as far as the petioles of its highest unfolded leaves, were full of the colouring-matter; and on applying chloride of tin to the cut surfaces, the vessels assumed that purplish red which this mordant produces when directly mixed with the logwood decoction. Subsequently, when one of the cotyledons was cut open by Prof. Oliver, to whom, in company with Dr. Hooker, I showed the specimen, we found that the whole of its vascular system was filled with the decoction, which everywhere gave the characteristic reaction. And it became manifest that the liquid absorbed through the rootlets, in the central vessels of which it was similarly traceable, had part of it passed directly up the vessels of the axis, while part of it had passed through other vessels into the cotyledon, out of which, no doubt, the liquid ordinarily so carried returns charged with a supply of the stored nutriment. I have since obtained a verification by varying the method. Digging up some young plants (Marigolds happened to afford the best choice) with large masses of soil round them, placing them in water, so as gradually to detach the soil without injuring the rootlets, planting them afresh in a flower-pot full of washed sand, and then, after a few days, watering them with the logwood decoction, I found, as before, that in less than twenty-four hours the colouring-matter had run up into the vessels of the leaves. Though the reaction produced by the mordant was not so strong as before, it was marked enough to be quite unquestionable.

As these experiments were so conducted that there was no access to the vessels except through the natural channels, and as the vital actions of the plants were so little interfered with that at the end of twenty-four hours they showed no traces of disturbance, I think the results must be held conclusive.

Taking it, then, as a fact that in plants possessing them the vessels and ducts are the channels through which sap is distributed, we come now to the further question, What determines the varying permeability of the walls of the vessels and ducts, and the consequent varying formation of wood? To this question I believe the true reply is, The exposure of the parts to intermittent mechanical strains, actual or potential, or both. By actual strains I of course mean those which the plant experiences in the course of its individual life. By potential strains I mean those which the form, attitude, and circumstances common to its kind involve, and which its inherited structure is adapted to meet. In plants with stems, petioles, and leaves, having tolerably constant attitudes, the increasing porosity of the tubes and consequent deposit of dense tissue, takes place in anticipation of the strains to which the parts of the individual are liable, but takes place at parts which have been habitually subject to such strains in ancestral individuals. But though in such plants the tendency to repeat that distribution of dense tissue caused by mechanical actions on past generations goes on irrespective of the mechanical actions to which the developing individual is subject, these direct actions, while they greatly aid the assumption of the typical structure, are the sole causes of those deviations in the relative thickenings of parts which distinguish the individual from others of its kind. And then, in certain irregularly growing plants, such as Cactuses and Euphorbias, where the strains fall on parts that do not correspond in successive individuals, we distinctly trace a direct relation between the degrees of strain and the rates of these changes which result in dense tissue. I will not occupy space in detailing the evidence of this relation, which is conspicuous in the orders named, but will pass to the question, What are the physical processes by which intermittent mechanical strains produce this deposit of resistant substance at places where it is needed to meet the strains? We have not to seek far for an answer. If a trunk, a bough, a shoot, or a petiole is bent by a gust of wind, the substance of its convex side is subject to longitudinal tension, the substance of its concave side being at the same time compressed. This is the primary mechanical effect. There is, however, a secondary mechanical effect, which here chiefly concerns us. That bend by which the tissues of the convex side are stretched, also produces lateral compression of them. Buttoning on a tight glove and then closing the hand, will make this necessity clear: the leather, while it is strained along the backs of the fingers, presses with considerable force on the knuckles. It is demonstrable that the tensions of the outer layer of a mass made convex by bending, must, by composition of forces, produce at every point a resultant at right angles to the layer beneath it—that, similarly, the joint tensions of these two layers must throw a pressure on the next deeper layer—and so on. Hence if, at some little distance beneath the surface of a stem, twig, or leaf-stalk, there exist longitudinal tubes, these tubes must be squeezed each time the side of the branch they are placed on becomes convex. Modifying the illustration just drawn from the clenched hand will make this clear. When, on forcibly grasping something, the skin is drawn tightly over the back of the hand, the whitening of the knuckles shows how the blood is expelled from the vessels below the surface by the pressure of the tightened skin. If, then, the sap-vessels must be thus compressed, what will happen to the liquid they contain? It will move away along the lines of least resistance. Part, and probably the greater part, will escape lengthways from the place of greatest pressure, some of it being expelled downwards, and some of it upwards. But, at the same time, part of it will be likely to ooze through the walls of the tubes. If these walls are so perfect as to permit the passage of liquid only by osmose, it may still be inferred that the osmose will increase under pressure; and probably, under recurrent pressure, the places at which the osmotic current passes most readily will become more and more permeable, until they eventually form pores. At any rate it is manifest that where pores and slits exist, whether thus formed or formed in any other way, the escape of sap into the adjacent tissue at each bend will become easy and rapid. What further must happen? When the branch or shoot recoils, the vessels on the side that was convex, being relieved from pressure, will tend to resume their previous diameters; and will be helped to do this by the elasticity of the surrounding tissue, as well as by those spiral, annular, and allied structures which they contain. But this resumption of their previous diameters must cause an immediate rush of sap back into them. Whence will it come? Not to any considerable extent from the surrounding tissues into which part of it has been squeezed, seeing that the resistance to the return of liquid through small pores will be greater than the resistance to its return along the vessels themselves. Manifestly the sap which was thrust up and down the vessels from the place of compression will return—the quantities returning from above and from below varying, as we shall hereafter see, according to circumstances. But this is not all. From some side a greater quantity must come back than was sent away; for the amount that has escaped out of the tube into the prosenchyma has to be replaced. Thus during the time when the side of the branch or twig becomes concave, more sap returns from above or below than was expelled upwards or downwards during the previous compression. The re-filled vessels, when the next bend renders their side convex, again have part of their contents forced through their parietes, and are again refilled in the same way. There is thus set up a draught of sap to the place where these intermittent strains are going on, an exudation proportionate to the frequency and intensity of the strains, and a proportionate nutrition or thickening of the wood-cells, fitting them to resist the strains. A rude idea of this action may be obtained by grasping in one hand a damp sponge, having its lower end in water, while holding a piece of blotting-paper in contact with its upper end, and then giving the sponge repeated squeezes. At each squeeze some of the water will be sent into the blotting-paper; at each relaxation the sponge will refill from below, to give another portion of its contents to the blotting-paper when again squeezed.

But how does this explanation apply to roots? If the formation of wood is due to intermittent transverse strains, such as are produced in the aërial parts of upright plants by the wind, how does it happen that woody matter is deposited in roots, where there are no lateral oscillations, no transverse strains? The answer is, that longitudinal strains also are capable of causing the effects described. It is true that perfectly straight fibres united into a bundle and pulled lengthways would not exert on one another any lateral pressure, and would not laterally compress any similarly straight canals running along with them. But if the fibres united into a bundle are variously bent or twisted, they cannot be longitudinally strained without compressing one another and structures imbedded in them. It needs but to watch a wet rope drawn tight by a capstan, to see that an action like that which squeezes the water out of its strands, will squeeze the sap out of the vessels of a root into the surrounding tissue, as often as the root is pulled by the swaying of the plant it belongs to. Here, too, as before, the vessels will refill when the pull intermits; and so, in the roots as in the branches, this rude pumping process will produce a growth of hard tissue proportionate to the stress to be borne.

These conclusions are supported by the evidence which exceptional cases supply. If intermittent mechanical strains thus cause the formation of wood where wood is found, then where it is not found, there should be an absence of intermittent mechanical strains. There is such an absence. Vascular plants characterized by little or no deposit of dense substance are those having vessels so conditioned that no considerable pressures are borne by them. The more succulent a petiole or leaf becomes, the more do the effects of transverse strains fall on its outer layers of cells. Its mechanical support is chiefly derived from the ability of these minute vesicles, full of liquid, to resist bursting and tearing under the compressions and tensions they are exposed to. And just as fast as this change from a thin leaf or foot-stalk to a thick one entails increasing stress on the superficial tissue, so fast does it diminish the stress on the internally-seated vascular tissue. The succulent leaf cannot be swayed about by the wind as much as an ordinary leaf; and such small bends as can be given to it and its foot-stalk are prevented from affecting in any considerable degree the tubes running through its interior. Hence the retentiveness of the vessels in these fleshy leaves, as shown by the small exudation of dye; and hence the small thickening of their surrounding prosenchyma by woody deposit. Still more conspicuously is this connexion of facts shown when, from the soft thick leaves before named and such others as those of *Echeveria*, *Rochea*, *Pereskia*, we turn to the thick leaves that have strong exo-skeletons. *Gasteria* serves as an illustration. The leathery or horny skin here evidently bears the entire weight of the leaf, and is so stiff as to prevent any oscillation. Here, then, the vessels running inside are protected from all mechanical stress; and accordingly we find that the cells surrounding them are not appreciably thickened.

Equally clear, and more striking because more obviously exceptional, is the evidence given by succulent stems which are leafless. *Stapelia Buffonia*, having soft procumbent axes not liable to be bent backwards and forwards in any considerable degree by the wind, has, ramifying through its tissue, vessels that allow but an extremely slow escape of dye and have unthickened sheaths. Such of the Euphorbias as have acquired the fleshy character while retaining the arborescent growth, like *Euphorbia Canariensis*, teach us the same truth in another way. In them the formation of wood around the vessels is inconspicuous where the intermittent strains are but slight; but it is conspicuous at those joints on which lateral oscillations of the attached branches throw great extensions and compressions of tissue. Throughout the *Cactaceæ* we find varied examples of the alleged relation. *Mammillaria* furnishes a very marked one. The substance of one of these globular masses, resting on the ground, admits of no bending from side to side; and accordingly its large bundles of spiral and annular vessels, or partially united cells, have very feebly-marked sheaths not at all thickened. In such types as *Cereus* and *Opuntia* we see, as in the Euphorbias, that where little stress falls on the vessels, little deposit takes place around them; while there is much deposit where there is much stress. Here let me add a confirmation obtained since writing the above. After observing among the Cactuses the very manifest relation between strain and the formation of wood, I inquired of Mr. Croucher, the intelligent foreman of the Cactus-house at Kew, whether he found this relation a constant one. He replied that he did, and that he had frequently tested it by artificially subjecting parts of them to strains. Neglecting at the time to inquire how he had done this, it afterwards occurred to me that if he had so done it as to cause constant strains, the observed result would not tell in favour of the foregoing interpretation. Subsequently, however, I learned that he had produced the strains by placing the plants in inclined attitudes—a method which, by permitting oscillations of the strained joints, allowed the strains to intermit. And then, making the proof conclusive, Mr. Croucher volunteered the statement that where he had produced constant strains by tying, no formation of wood took place.

Aberrant growths of another class display the same relations of phenomena. Take first the underground stems, such as the Potato and the Artichoke. The vessels which run through these, slowly take up the dye without letting it pass to any considerable extent into the surrounding tissues*. Only after an interval of many hours does the prosenchyma become stained in some places. Here, as before, an absence of rapid exudation accompanies an absence of woody deposit; and both these go along with the absence of intermittent strains. Take again the fleshy roots. The Turnip, the Carrot, and the Beetroot have vessels that retain very persistently the coloured liquids they take up. And differing in this, as these roots do, from ordinary roots, we see that they also differ from them in not being woody, and in not being appreciably subject to the usual mechanical actions. In these cases, as in the others, parts that ordinarily become dense, deviate from this typical character when they are not exposed to those forces which produce dense tissue by increasing the extravasation of sap.

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* Those who repeat these experiments must be prepared for great irregularities in the rates of absorption. Succulent structures in general absorb much more slowly than others, and sometimes will scarcely take up the dye at all. The differences between different structures, and the same structure at different times, probably depend on the degrees in which the tissues are charged with liquid and the rates at which they are losing it by evaporation.

To complete the proof that such a relation exists, let me add the results of some experiments on equal and similarly-developed parts, kept respectively at rest and in motion. I have tested the effects on large petioles, on herbaceous shoots, and on woody shoots. If two such petioles as those of Rhubarb, with their leaves attached, have their cut ends inserted in bottles of dye, and the one be bent backwards and forwards while the other remains motionless, there arises, after the lapse of a hour, scarcely any difference in the states of their vessels: a certain proportion of these are in both cases charged with the dye, and little exudation has been produced by the motion. Here, however, it is to be observed that the causes of exudation are scarcely operative: the vascular bundles are distributed all through the mass of the petiole, which is formed of soft watery tissue; and they are, therefore, not so circumstanced as to be effectually compressed by the bends. In herbaceous stems, such as those of the Jerusalem Artichoke and of the Foxglove, an effect scarcely more decided is produced; and here, too, when we seek a reason, we find it in the non-fulfilment of the mechanical conditions; for the vascular bundles are not so seated between a tough layer of bark and a solid core as to be compressed at each bend. When, however, we come to experiment upon woody shoots, we meet with conspicuous effects, though by no means uniformly. In some cases oscillations produce immense amounts of exudation—parallel transverse sections of the compared shoots showing that where, in the one that has been at rest, there are spots of colour round but a few pitted ducts, in the one that has been kept in motion the substance of the wood is soaked almost uniformly through with dye. In other cases, especially where there is much undifferentiated tissue remaining, the exudation is not very marked. The difference appears to depend on the quantity of liquid contained in the shoot. If its substance is relatively dry, the exudation is great; but it is comparatively small if all the tissues are fully charged with sap. This contrast of results is one which contemplation of the mechanical actions will lead us to expect.

And now, with these facts to aid our interpretation, let us return to ordinary stems. If the upper end of a growing shoot the prosenchyma of which is but little thickened be allowed to imbibe the dye, the vessels of its medullary sheath alone become charged; and from them there takes place but a slow oozing. If a like experiment be tried with a lower part of the shoot, where the wood in course of formation has its inner boundary marked but not its outer boundary, we find that the pitted ducts, and more especially the inner ones, come into play. And then lower still, where the wood has its periphery defined and its histological characters decided, the appearances show that the tissue forming its outer surface begins to take a leading part in the transmission of liquid. What now is the explanation of these changes, mechanically considered? In the young soft part of the shoot, as in all normal and abnormal growths that have not formed wood, the channels for the passage of sap are the spiral, annular, fenestrated, or reticulated vessels. These vessels, here included in the bundles of the medullary sheath, are, in common with the tissues around them, subject, by the bendings of the shoot, to slight intermittent compressions, and, especially the outermost of them, are thus forced to give the prosenchyma an extra supply of nutritive liquid. The thickening of the prosenchyma, spreading laterally as well as outwards from each bundle of the medullary sheath, goes on until it meets the thickenings that spread from the other bundles; and there is so formed an irregular cylinder of hardened tissue, surrounding the medulla and the vascular bundles of its sheath. As soon as this happens, these vascular bundles become, to a considerable extent, shielded from the effects of transverse strains, since the tensions and compressions chiefly fall on the developing wood outside of them. Clearly, too, the greatest stress must be felt by the outer layer of the developing wood: being further removed from the neutral axis, it must be subject to severer strains at each bend; and lying between the bark and the layer of wood first formed, it must be most exposed to lateral compressions. Among the elongated cells of this outer layer, some unite to form the pitted ducts. Being, as we see, better circumstanced mechanically, they become greater carriers of sap than the original vessels, and, in consequence of this, as well as in consequence of their relative proximity, become the sources of nutrition to the still more external layers of wood-cells. The same causes and the same effects hold with each new indurated coat deposited round the previously indurated coats.

This description may be thought to go far towards justifying the current views respecting the course taken by the sap. But the justification is more apparent than real. In the first place, the implication here is that the sap-carrying function is at first discharged entirely by the vessels of the medullary sheath, and that they cease to discharge this function only as fast as they are relatively incapacitated by their mechanical circumstances. And the second implication is, that it is not the wood itself, but the more or less continuous canals formed in it which are the subsequent sap-distributors. This, though readily made clear by microscopic examination of the large pitted ducts in a partially lignified shoot that has absorbed the dye, is less manifestly true of the peripheral layer of sap-carrying tissue finally formed. But it is really true here. For this layer, though nominally a layer of wood, is practically a layer of inosculating vessels. It is formed out of irregular lines and networks of elongated pitted cells, obliquely united by their ends. Examination of them after absorption of a dye, shows that it is only along the continuous channels they unite to form that the current has passed. But the essentially vascular character of this outer and latest-formed layer of the alburnum is best seen in the fact that the vascular systems of new axes take their rise from it, and form with it continuous canals. If a shoot of last year in which growth is recommencing, be cut lengthways after it has imbibed a a dye, clear proof is obtained that the passage of the dye into a lateral bud takes place from this outermost layer of pitted cells, and that the channels taken by the dye through the new tissue are composed of cells that pass through modified forms into the spiral vessels of the new medullary sheath. This transition may be still more clearly traced in a terminal bud that continues the line of last year's shoot. A longitudinal section of this shows that the vessels of the new medullary sheath do not obtain their sap from the vessels of last year's sheath (which, as shown by the non-absorption of dye, have become inactive), but that their supplies are obtained from those inosculating canals formed out of last year's outermost layer of prosenchyma, and that between the component cells of this and those of the new vascular system there are all gradations of structure *.

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* It may be added here that, on considering the mechanical actions that must go on, we are enabled in some mea-

It is not the aim of the foregoing reasoning to show that mechanical actions are the sole causes of the formation of dense tissue in plants. Dense tissue is in many cases formed where no such causes have come into play—as, for example, in thorns and in the shells of nuts. Here the natural selection of variations can alone have operated. It is manifest, too, that even those supporting structures the building up of which is above ascribed to intermittent strains, may, in the individual plant of a species that ordinarily has them, be developed to a great extent when intermittent strains are prevented. We see this in trees that are artificially supported by nailing to walls; and we also see a kindred fact in natural climbers. Though in these cases the formation of wood is obviously less than it would be were the stem and branches habitually moved about by the wind, it nevertheless goes on. Clearly the tendency of the plant to repeat the structure of its type (in the one case the structure of its species, and in the other case that of the order from which it has diverged in becoming a climber) is here almost the sole cause of wood-formation. But though in plants so circumstanced intermittent mechanical strains have little or no direct share, it may still be true, and I believe is true, that intermittent mechanical strains are the original cause; for, as before hinted, the typical structure which the individual thus repeats irrespective of its own conditions, is interpretable as a typical structure that is itself the product of these actions and reactions between the plant and its environment. Grant the inheritance of functionally produced modifications; grant that natural selection will always cooperate in such way as to favour those individuals and families in which functionally produced modifications have progressed most advantageously; and it will follow that this mechanically caused formation of

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sure to understand both how such inosculating channels are initiated, and how the structures of their component cells are explicable. What must happen to one of these elongated prosenchyma-cells if, in the course of its development, it is subject to intermittent compressions? Its squeezed-out liquid while partially escaping laterally, will more largely escape upwards and downwards; and while repeated lateral escape will tend to form lateral channels communicating with laterally-adjacent cells, repeated longitudinal escape will tend to form channels communicating with longitudinally-adjacent cells—so producing continuous though irregular longitudinal canals. Meanwhile each cell into and out of which the nutritive liquid is from time to time squeezed through small openings in its walls, cannot thicken internally in an even manner: deposition will be interfered with by the passage of the currents through the pores. The rush to or from each pore will tend to maintain a funnel-shaped depression in the deposit around; and the passage from cell to cell will so acquire just that shape which the microscope shows us—two hollow cones with their apices meeting at the point where the cell-membranes are in contact. Moreover, as confirming this interpretation, it may be remarked that we are thus supplied with a reason for the differences of shape between these passages from one pitted cell to another, and the analogous passages that exist between cells otherwise formed and otherwise conditioned. In the cells of the medulla, and others which are but little exposed to compression, the passages are severally formed more like a tube with two trumpet-mouths, one in each cell. This is just the form which might be expected where the nutritive fluid passes from cell to cell in moderate currents, and not by the violent rushes caused by intermittent pressures. Of course it is not meant that in each individual cell these structures are determined by these mechanical actions. The facts clearly negative any such conclusion, showing us, as they in many cases do, that these structures are assumed in advance of these mechanical actions. The implication is, that such mechanical actions initiated modifications that have, with the aid of natural selection, been accumulated from generation to generation; until, in conformity with ordinary embryological laws, the cells of the parts exposed to such actions assume these special structures irrespective of the actions—the actions, however still serving to aid and complete the assumption of the inherited type.

dense substance, accumulating from generation to generation by the survival of the fittest, will result in an organic habit of forming dense tissue at the required places. The deposit arising from exudation at the places of greatest strain, recurring from generation to generation at the same places, will come to be reproduced in anticipation of strain, and will continue to be reproduced for a long time after a changed habit of the species prevents the strain—eventually, however, decreasing, both through functional inactivity and natural selection, to the point at which it is in equilibrium with the requirement.

Another side of the general question may now be considered. We have seen how, by intermittent pressures on capillary vessels and ducts and inosculating canals, there must be produced a draught of sap towards the point of compression to replace the sap squeezed out. But we have still to inquire what will be the effect on the distribution of sap throughout the plant as a whole. It was concluded that out of the compressed vessels the greater part of the liquid would escape longitudinally—the longitudinal resistance to movement being least. In every case the probabilities are infinity to one against the resistances being equal upwards and downwards. Always, then, more sap will be expelled in one direction than in the other. But in whichever direction least sap is expelled, from that same direction most sap will return when the vessels are relieved from pressure—the force which is powerful in arresting the back current in that direction being the same force which is powerful in producing a forward current. Ordinarily, the more abundant supply of liquid being from below, there will result an upward current. At each bend a portion of the contents will be squeezed out through the sides of the vessels—a portion will be squeezed downwards, reversing the current ascending from the roots, but soon stopped by its resistance; while a larger portion will be squeezed upwards towards the extremities of the vessels, where consumption and loss are most rapid. At each recoil the vessels will be replenished, chiefly by the repressed upward current; and at the next bend more of it will be thrust onwards than backwards. Hence we have everywhere in action a kind of rude force-pump, worked by the wind; and we see how sap may thus be raised to a height far beyond that to which it could be raised by capillary action, aided by osmose and evaporation.

Thus far, however, the argument proceeds on the assumption that there is liquid enough to replenish every time the vessels subject to this process. But suppose the supply fails—suppose the roots have exhausted the surrounding stock of moisture. Evidently the vessels thus repeatedly having their contents squeezed out into the surrounding tissue, cannot go on refilling themselves from other vessels without tending to empty the vascular system. On the one hand, evaporation from the leaves causing a draught on the capillary tubes that end in them, continually generates a capillary tension upwards; while, on the other hand, the vessels below, expanding after their sap has been squeezed out, produce a tension both upwards and downwards towards the point of loss. Were the limiting membranes of the vessels impermeable, the movement of sap would, under these conditions, soon be arrested. But these membranes are permeable; and the surrounding tissues readily permit the passage of air. This state of tension, then, will cause an entrance of air into the tubes: the columns of liquid they contain will be interrupted by bubbles. It seems, indeed, not improbable that this entrance of air may take place even when there is a good supply of liquid, if the mechanical strains are so violent and the exudation so rapid that the currents cannot refill the half-emptied vessels with sufficient rapidity. And in this case the intruding air may possibly play the same part as that contained in the air-chamber of a force-pump—tending, by moderating the violence of the jets, and by equalizing the strains, to prevent rupture of the apparatus. Of course when the supply of liquid becomes adequate, and the strains not too violent, these bubbles will be expelled as readily as they entered.

Here, as before, let me add the conclusive proof furnished by a direct experiment. To ascertain the amount of this propulsive action, I took from the same tree, a Laurel, two equal shoots, and, placing them in the same dye, subjected them to conditions that were alike in all respects save that of motion: while one remained at rest, the other was bent backwards and forwards, now by switching and now by straining with the fingers. After the lapse of an hour I found that the dye had ascended the oscillating shoot three times as far as it had ascended the stationary shoot—this result being an average from several trials. Similar trials brought out similar effects in other structures. The various petioles and herbaceous shoots experimented upon for the purpose of ascertaining the amount of exudation produced by transverse strains, showed also the amount of longitudinal movement. It was observable that the height ascended by the dye was in all cases greater where there had been oscillation than where there had been rest—the difference, however, being much less marked in succulent structures than in woody ones.

It need scarcely be said that this mechanical action is not here assigned as the sole cause of circulation, but as a cause cooperating with others, and helping others to produce effects that could not otherwise be produced. Trees growing in conservatories afford us abundant proof that sap is raised to considerable heights by other forces. Though it is notorious that trees so circumstanced do not thrive unless, through open sashes, they are frequently subject to breezes sufficient to make their parts oscillate, yet there is evidently a circulation that goes on without mechanical aid. The *causes* of circulation are those actions only which disturb the liquid equilibrium in a plant, by permanently abstracting water or sap from some part of it; and of these the first is the absorption of materials for the formation of new tissue in growing parts; the second is the loss by evaporation, mainly through adult leaves; and the third is the loss by extravasation, through compressed vessels. Only so far as it produces this last can mechanical strain be regarded as truly a cause of circulation. All the other actions concerned must be classed as *aids* to circulation—as facilitating that redistribution of liquid that continually restores the equilibrium continually disturbed; and of these, capillary action may be named as the first, osmose as the second, and the propulsive effect of mechanical strains as the third. The first two of these aids are doubtless capable by themselves of producing a large part of the observed result—more of the observed result than is at first sight manifest; for there is an important indirect effect of osmotic action which appears to be overlooked. Osmose does not aid circulation only by setting up, within the plant, exchange currents between the more dense and the less dense solutions in different parts of it; but it aids circulation much more by producing distention of the plant as a whole. In consequence of the average contrast in density between the water outside of the plant and the sap inside of it, the constant tendency is for the plant to absorb a quantity in excess of its capacity, and so to produce distention and erection of its tissues. It is because of this that the drooping plant raises itself when watered; for capillary action alone could only refill its tissues without changing their attitudes. And it is because of this that juicy plants with collapsible structures bleed so rapidly when cut, not only from the cut surface of the rooted part, but from the cut surface of the detached part—the elastic tissues tending to press out the liquid which distends them. And manifestly if osmose serves thus to maintain a state of distention throughout a plant, it indirectly furthers circulation, since immediately evaporation or growth at any part, by abstracting liquid from the neighbouring tissues, begins to diminish the liquid pressure within such tissues, the distended structures throughout the rest of the plant thrust their liquid contents towards the place of diminished pressure. This, indeed, may very possibly be the most efficient of the agencies at work. Remembering how great is the distention producible by osmotic absorption—great enough to burst a bladder—it is clear that the force with which the distended tissues of a plant urge forward the sap to places of consumption is probably very great. We must therefore regard the aid which mechanical strains give as being one of several. Oscillations help directly to restore any disturbed liquid equilibrium; and they also help indirectly, by facilitating the redistribution caused by capillary action and the process just described; but in the absence of oscillations the equilibrium may still be restored, though less rapidly and within narrower limits of distance.

One half of the problem of the circulation, however, has been left out of sight. Thus far our inquiry has been, how the ascending current of sap is produced. There remains the rationale of the descending current. What forces cause it, and through what tissues it takes place, are questions to which no satisfactory answers have been given. That the descent is due to gravitation, as some allege, is difficult to conceive, since, as gravitation acts equally on all liquid columns contained in the stem, it is not easy to see why it should produce downward movements in some while permitting upward movements in others—unless, indeed, there existed descending tubes too wide to admit of much capillary action, which there do not. Moreover gravitation is clearly inadequate to cause currents towards the roots out of branches that droop to the ground. Here the gravitation of its contained liquid columns must nearly balance that of the connected columns in the stem, leaving no appreciable force to cause motion. Nor does there seem much probability in the assumption that the route of the descending sap is through the cambium layer, since experiments on the absorption of dyes prove that simple cellular tissue is a very bad conductor of liquids: their movement through it does not take place with one-fiftieth of the rapidity with which it takes place through vessels*.

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* Some exceptions to this occur in plants that have retrograded in the character of their tissues towards the simpler vegetal types. Certain very succulent leaves, such as those of *Sempervivum*, in which the cellular tissue is immensely developed in comparison with the vascular tissue, seem to have resumed to a considerable extent what we must regard as the primitive form of vegetal circulation—simple absorption from cell to cell. These, when they have lost much

Of course the defence for these hypotheses is, that there must be a downward current, which must have a course and a cause; and the very natural assumption has been that the course and the cause must be other than those which produce the ascending current. Nevertheless there is an alternative supposition, to which the foregoing considerations introduce us. It is quite possible for the same vascular system to serve as a channel for movement in opposite directions at different times. We have among animals well-known cases in which the blood-vessels carry a current first in one direction and then, after a brief pause, in the reverse direction. And there seems an *à priori* probability that, lowly organized as they are, plants are more likely to have distributing appliances of this imperfect kind than to have two sets of channels for two simultaneous currents. If, led by this suspicion, we inquire whether among the forces which unite to produce movements of sap, there are any variations or intermissions capable of determining the currents in different directions, we quickly discover that there are such, and that the hypothesis of an alternating motion of the sap, now centrifugal and now centripetal, through the same vessels, has good warrant. What are the several forces at work? First may be set down that tendency existing in every part of a plant to expand into its typical form, and to absorb nutritive liquids in doing this. The resulting competition for sap will, other things being equal, cause currents towards the most rapidly-growing parts—towards unfolding shoots and leaves, but not towards adult leaves. Next we have evaporation, acting more on the adult leaves than on those which are in the bud, or but partially developed. This evaporation is both regularly and irregularly intermittent. Depending chiefly on the action of the sun, it is, in fine weather, greatly checked or wholly arrested every evening; and in cloudy weather must be much retarded during the day. Further, every hygrometric variation, as well as every variation in the movement of the air, must vary the evaporation. This chief action, therefore, which, by continually emptying the ends of the capillary tubes, makes upward currents possible, is one which intermits every night, and every day is strong or feeble as circumstances determine. Then, in the third place, we have this rude pumping process above described, going on with greater vigour when the wind is violent, and with less vigour when it is gentle—drawing liquid *towards* different parts according to their degrees of oscillation, and *from* different parts according as they can most readily furnish it. And now let us ask what must result under changing conditions from these variously conflicting and conspiring forces. When a warm sunshine, causing rapid evaporation, is emptying the vessels of the leaves, the osmotic and capillary actions that refill them will be continually aided by the pumping action of the swaying petioles, twigs, and branches, provided their oscillations are moderate. Under these conditions the current of sap, moving in the direction of least resistance, will set towards the leaves. But what will happen when the sun sets? There is now

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of their water, will take up the dye to some distance through their general substance, or rather through its interstices, even neglecting the vessels. At other times, in the same leaves, the vessels will become charged while comparatively little absorption takes place through the cellular tissue. Even in these exceptional cases, however, the movement through cellular tissue is nothing like as fast as the movement through vessels.

nothing to determine currents either upwards or downwards, except the relative rates of growth in the parts and the relative demands set up by the oscillations; and the oscillations acting alone, will draw sap to the oscillating parts as much from above as from below. If the resistance to be overcome by a current setting back from the leaves is less than the resistance to be overcome by a current setting up from the roots, then a current will set back from the leaves. Now it is, I think, tolerably manifest that in the swaying twigs and minor branches, less force will be required to overcome the inertia of the short columns of liquid between them and the leaves than to overcome the inertia of the long columns between them and the roots. Hence during the night, as also at other times when evaporation is not going on, the sap will be drawn out of the leaves into the adjacent supporting parts; and their nutrition will be increased. If the wind is strong enough to produce a swaying of the thicker branches, the back current will extend to them also; and a further strengthening will result from their absorption of the elaborated sap. And when the great branches and the stem are bent backwards and forwards by a gale, they too will share in the nutrition. It may at first sight seem that these parts, being nearer to the roots than to the leaves, will draw their supplies from the roots only. But the quantity which the roots can furnish is insufficient to meet so great a demand. Under the conditions described, the exudation of sap from the vessels will be very great, and the draught of liquid required to refill them, not satisfied by that which the root-fibres can take in, will extend to the leaves. Thus sap will flow to the several parts according to their respective degrees of activity—to the leaves while light and heat enable them to discharge their functions, and back to the twigs, branches, stem, and roots when these become active and the leaves inactive, or when their activity dominates over that of the leaves. And this distribution of nutriment, varying with the varying activities of the parts, is just such a distribution as we know must be required to keep up the organic balance.

To this explanation it may be objected that it does not account for the downward current of sap in plants that are sheltered. The stem and roots of a drawing-room Geranium display a thickening which implies that nutritive matters have descended from the leaves, although there are none of these oscillations by which the sap is said to be drawn downwards as well as upwards. The reply is, that the stem and roots tend to repeat their typical structures and that the absorption of sap for the formation of their respective dense tissues, is here the force which determines the descent. Indeed it must be borne in mind that the mechanical strains and the pumping process which they keep up, as well as the distention caused by osmose, do not in themselves produce a current either upwards or downwards: they simply help to move the sap towards that place where there is the most rapid abstraction of it—the place towards which its motion is least resisted. Whether there is oscillation or whether there is not, the physiological demands of the different parts of the plant determine the direction of the current; and all which the oscillations and the distention do is to facilitate the supply of these demands. Just as much, therefore, in a plant at rest as in a plant in motion, the current will set downwards when the function of the leaves is arrested, and when there is nothing to resist that abstraction of sap caused by the tendency of the stem- and root-tissues to assume their typical structures. To which admission, however, it must be added that since this typical structure assumed, though imperfectly assumed, by the hot-house plant, is itself interpretable as the inherited effect of external mechanical actions on its ancestors, we may still consider the current set up by the assumption of the typical structure to be indirectly due to such actions.

Interesting evidence of another order here demands notice. In the course of experiments on the absorption of dyes by leaves, it happened that in making sections parallel to the plane of a leaf, with the view of separating its middle layer containing the vessels, I came upon some structures that were new to me. These structures, where they are present, form the terminations of the vascular system. They are masses of irregular and imperfectly united fibrous cells, such as those out of which vessels are developed; and they are sometimes slender, sometimes bulky—usually, however, being more or less club-shaped. In transverse sections of leaves their distinctive characters are not shown; they are taken for the smaller veins. It is only by carefully slicing away the surface of a leaf until we come down to that part which contains them, that we get any idea of their nature. Fig. 1 (Plate LIV.) represents a specimen taken from a leaf of *Euphorbia neriifolia.* Occupying one of the interspaces of the ultimate venous network, it consists of a spirally lined duct or set of ducts, which connects with the neighbouring vein a cluster of half-reticulated, half-scalariform cells. These cells have projections, many of them tapering, that insert themselves into the adjacent intercellular spaces, thus producing an extensive surface of contact between the organ and the imbedding tissues. A further trait is, that the ensheathing prosenchyma is either but little developed or wholly absent; and consequently this expanded vascular structure, especially at its end, comes immediately in contact with the tissues concerned in assimilation. The leaf of *Euphorbia neriifolia* is a very fleshy one; and in it these organs are distributed through a compact, though watery, cellular mass. But in any leaf of the ordinary type which possesses them, they lie in the network parenchyma composing its lower layer; and wherever they occur in this layer its cells unite to enclose them. This arrangement is shown in fig. 2, representing a sample from the Caoutchouc-leaf, as seen with the upper part of its envelope removed; and it is shown still more clearly in a sample from the leaf of *Panax Lessonii*, fig. 3. Figures 4 and 5 represent, without their sheaths, other such organs from the leaves of *Panax Lessonii* and *Clusia flava.* Some relation seems to exist between their forms and the thicknesses of the layers in which they lie. Certain very thick leaves, such as those of *Clusia flava*, have them less abundantly distributed than is usual, but more massive. Where the parenchyma is developed not to so great an extreme, though still largely, as in the leaves of Holly, *Aucuba*, *Camellia*, they are not so bulky; and in thinner leaves, like those of Privet, Elder, &c., they become longer and less conspicuously club-shaped. Some adaptations to their respective positions seem implied by these modifications; and we may naturally expect that in many thin leaves these free ends, becoming still narrower, lose the distinctive and suggestive characters possessed by those shown in the diagrams. Relations of this kind are not regular, however. In various other genera, members of which I have examined, as *Rhus*, *Viburnum*, *Griselinia*, *Brexia*, *Botryodendron*, *Pereskia*, the variations in the bulk and form of these structures are not directly determined by the spaces which the leaves allow: obviously there are other modifying causes. It should be added that while these expanded free extremities graduate into tapering free extremities, not differing from ordinary vessels, they also pass insensibly into the ordinary inosculations. Occasionally, along with numerous free endings, there occur loops; and from such loops there are transitions to the ultimate meshes of the veins.

These organs are by no means common to all leaves. In many that afford ample spaces for them they are not to be found. So far as I have observed, they are absent from the thick leaves of plants which form very little wood. In *Sempervivum*, in *Echeveria*, in *Bryophyllum*, they do not appear to exist; and I have been unable to discover them in *Kalanchoë rotundifolia*, in *Kleinia ante-euphorbium* and *ficoides*, in the several species of *Crassula*, and in other succulent plants. It may be added that they are not absolutely confined to leaves, but occur in stems that have assumed the functions of leaves. At least I have found, in the green parenchyma of *Opuntia*, organs that are analogous though much more rudely and irregularly formed. In other parts, too, that have usurped the leaf-function, they occur, as in the phyllodes of the Australian Acacias. These have them abundantly developed; and it is interesting to observe that here, where the two vertically placed surfaces of the flattened-out petiole are equally adapted to the assimilative function, there exist two layers of these expanded vascular terminations, one applied to the inner surface of each layer of parenchyma.

Considering the structures and positions of these organs, as well as the natures of the plants possessing them, may we not form a shrewd suspicion respecting their function? Is it not probable that they facilitate absorption of the juices carried back from the leaf for the nutrition of the stem and roots? They are admirably adapted for performing this office. Their component fibrous cells, having angles insinuated between the cells of the parenchyma, are shaped just as they should be for taking up its contents; and the absence of sheathing tissue between them and the parenchyma facilitates the passage of the elaborated liquids. Moreover there is the fact that they are allied to organs which obviously have absorbent functions. I am indebted to Dr. Hooker for pointing out the figures of two such organs in the "Icones Anatomicæ" of Link. One of them is from the end of a dicotyledonous root-fibre, and the other is from the prothallus of a young Fern. In each case a cluster of fibrous cells, seated at a place from which liquid has to be drawn, is connected by vessels with the parts to which liquid has to be carried. There can scarcely be a doubt, then, that in both cases absorption is effected through them. I have met with another such organ, more elaborately constructed but evidently adapted to the same office, in the common Turnip-root. As shown by the end view and longitudinal section in figs. 6 and 7, this organ consists of rings of fenestrated cells, arranged with varying degrees of regularity into a funnel, ordinarily having its apex directed towards the central mass of the Turnip, with which it has, in some cases at least, a traceable connexion by a canal. Presenting as it does an external porous surface terminating one of the branches of the vascular system, each of these organs is well fitted for taking up with rapidity the nutriment laid by in the Turnip-root, and used by the plant when it sends up its flower-stalk. Nor does even this exhaust the analogies.

The cotyledons of the young bean, experimented upon as described at page 410, furnished other examples of such structures, exactly in the places where, if they are absorbents, we might expect to find them. Amid the branchings and inosculations of the vascular layer running through the mass of nutriment deposited in each cotyledon, there are conspicuous free terminations that are club-shaped, and prove to be composed, like those in leaves, of irregularly formed and clustered fibrous cells; and some of them, diverging from the plane of the vascular layer, dip down into the mass of starch and albumen which the young plant has to utilize, and which these structures can have no other function but to take up.

Besides being so well fitted for absorption, and besides being similar to organs which we cannot doubt are absorbents, these vascular terminations in leaves afford us yet another evidence of their functions. They are seated in a tissue so arranged as specially to facilitate the abstraction of liquid. The centripetal movement of the sap must be set up by a force that is comparatively feeble, since, the parietes of the ducts being porous, air will enter if the tension on the contained columns becomes considerable. Hence it is needful that the exit of sap from the leaves should meet with very little resistance. Now were it not for an adjustment presently to be described, it would meet with great resistance, notwithstanding the peculiar fitness of these organs to take it in. Liquid cannot be drawn out of any closed cavity without producing a collapse of the cavity's sides; and if its sides are not readily collapsible, there must be a corresponding resistance to the abstraction of liquid from it. Clearly the like must happen if the liquid is to be drawn out of a tissue which cannot either diminish in bulk bodily or allow its components individually to diminish in bulk. In an ordinary leaf, the upper layer of parenchyma, formed as it is of closely packed cells that are without interspaces, and are everywhere held fast within their framework of veins, can neither contract easily as a mass, nor allow its separate cells to do so. Quite otherwise is it with the network parenchyma below. The long cells of this, united merely by their ends and having their flexible sides surrounded by air, may severally have their contents considerably increased and decreased without offering appreciable resistances; and the network tissue which they form will, at the same time, be capable of undergoing slight expansions and contractions of its thickness. In this layer occur these organs that are so obviously fitted for absorption. Here we find them in direct communication with its system of collapsible cells. The probability appears to be, that when the current sets into the leaf, it passes through the vessels and their sheaths chiefly into the upper layer of cells (this upper layer having a larger surface of contact with the veins than the lower layer, and being the seat of more active processes); and that the juices of the upper layer, enriched by the assimilated matters, pass into the network parenchyma, which serves as a reservoir from which they are from time to time drawn for the nutrition of the rest of the plant, when the actions determine the downward current. Should it be asked what happens where the absorbents, instead of being inserted in a network parenchyma, are, as in the leaves of *Euphorbia neriifolia*, inserted in a solid parenchyma, the reply is, that such a parenchyma, though not furnished with systematically arranged air-chambers, nevertheless contains air in its intercellular spaces; and that when there occurs a draught upon its contents, the expansion of this air and the entrance of more m without, quickly supply the place of the abstracted liquid.

If, then, returning to the general argument, we conclude that these expanded terminations of the vascular system in leaves are absorbent organs, we find a further confirmation of the views set forth respecting the alternating movement of the sap along the same channels. These spongioles of the leaves, like the spongioles of the roots, being appliances by which liquid is taken up to be carried into the mass of the plant, we are obliged to regard the vessels that end in these spongioles of the leaves as being the channels of the down current whenever it is produced. If the elaborated sap is abstracted from the leaves by these absorbents, then we have no alternative but to suppose that, having entered the vascular system, the elaborated sap descends through it. And seeing how, by the help of these special terminations, it becomes possible for the same vessels to carry back a quality of sap unlike that which they bring up, we are enabled to understand tolerably well how this rhythmical movement produces a downward transfer of materials for growth.

The several lines of argument may now be brought together; and along with them may be woven up such evidences as remain. Let me first point out the variety of questions to which the hypothesis supplies answers.

It is required to account for the ascent of sap to a height beyond that to which capillary action can raise it. This ascent is accounted for by the propulsive action of transverse strains, joined with that of osmotic distention. A cause has to be assigned for that rise of sap which, in the spring, while yet there is no considerable evaporation to aid it, goes on with a power which capillarity does not explain. The cooperation of the same two agencies is assignable for this result also[*]. The circumstance that vessels and ducts here contain sap and there contain air, and at the same place contain at different seasons now air and now sap, is a fact calling for explanation. An explanation is furnished by these mechanical actions which involve the entrance or expulsion of air according to the supply of liquid. That vessels and ducts which were originally active sap-carriers go completely out of use, and have their function discharged by other vessels or ducts, is an anomaly that has to be solved. Again, we are supplied with a solution: these deserted vessels and ducts are those which, by the formation of dense tissue outside of them, become so circumstanced that they cannot be compressed as they originally were. A channel has to be found for the downward current of sap, which, on any other hypothesis than the foregoing, must be a channel separate from that taken by the upward current; and yet no good evidence of a separate channel has been pointed out. Here, however, the difficulty disappears, since one channel suffices for the current alternating upwards and downwards according to the conditions. Moreover there has to be found a force producing or facilitating the downward current, capable even of drawing sap out of drooping branches; and no such force is forthcoming. The hypothesis set forth dispenses with this necessity: under the recurring change of conditions, the same distention and oscillation which before raised the sap to the places of consumption, now bring it down to the places of consumption. A physical process has to be pointed out by which the material that forms dense tissue is deposited at the places where it is wanted, rather than at other places. This physical process the hypothesis indicates. It is requisite to find an explanation of the fact that, when plants ordinarily swayed about by the wind are grown indoors, the formation of wood is so much diminished that they become abnormally slender. Of this an explanation is supplied. Yet a further fact to be interpreted is, that in the same individual plant homologous parts, which, according to the type of the plant, should be equally woody, become much thicker one than another if subject to greater mechanical stress. And of this too an interpretation is similarly afforded.

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[*] It seems probable, however, that osmotic distention is here, especially, the more important of the two factors. The rising of the sap in spring may indirectly result, like the sprouting of the seed, from the transformation of starch into sugar. During germination, this change of an oxy-hydro-carbon from an insoluble into a soluble form, leads to rapid endosmose, consequently to great distention of the seed, and therefore to a force which thrusts the contained liquids into the plumule and radicle, and gives them power to displace the soil in their way: it sets up an active internal movement when neither evaporation nor the change which light produces can be operative. And similarly, if, in the spring, the starch stored up in the roots of a tree passes into the form of sugar, the unusual osmotic absorption that arises will cause an unusual distention—a distention which, being resisted by the tough bark of the roots and stem, will result in a powerful upward thrust of the contained liquid.

Now the sufficiency of the assigned actions to account for so many phenomena not otherwise explained, would be strong evidence that the rationale is the true one, even were it of a purely hypothetical kind. How strong, then, becomes the reason for believing it the true one when we remember that the actions alleged demonstrably go on in the way asserted. They are ever operating before our eyes; and that they produce the effects in question is a conclusion deducible from mechanical principles, a conclusion established by induction, and a conclusion verified by experiment. These three orders of proof may be briefly summed up as follows.

That plants which have to raise themselves above the earth's surface, and to withstand the actions of the wind, must have a power of developing supporting structure, is an *à priori* conclusion which may be safely drawn. It is an equally safe *à priori* conclusion, that if the supporting structure, either as a whole or in any of its parts, has to adapt itself to the particular strains which the individual plant is subject to by its particular circumstances, there must be at work some process by which the strength of the supporting structure is everywhere brought into equilibrium with the forces it has to bear. Though the typical distribution of supporting structure in each kind of plant may be explained teleologically by those whom teleological explanations satisfy, and though otherwise this typical distribution may be ascribed to natural selection acting apart from any directly adaptive process, yet it is manifest that those departures from the typical distribution which fit the parts of each plant to their special conditions are explicable neither teleologically nor by natural selection. We are, therefore, compelled to admit that, if in each plant there goes on a balancing of the particular strains by the particular strengths, there must be a physical or physico-chemical process by which the adjustments of the two are effected. Meanwhile we are equally compelled to admit, *à priori*, that the mechanical actions to be resisted, themselves affect the internal tissues in such ways as to further the increase of that dense substance by which they are resisted. It is demonstrable that bending the petioles, shoots, and stems must compress the vessels beneath their surfaces, and increase the exudation of nutritive matters from them, and must do this actively in proportion as the bends are great and frequent; so that while, on the one hand, it is a necessary deduction that, if the parts of each plant are to be severally strengthened according to their several strains, there must be some direct connexion between strains and strengths, it is, on the other hand, a necessary deduction from mechanical principles that the strains do act in such ways as to aid the increase of the strengths. How a like correspondence between two *à priori* arguments holds in the case of the circulation, needs not to be shown in detail. It will suffice to remind the reader that while the raising of sap to heights beyond the limit of capillarity implies some force to effect it, we have in the osmotic distention and the intermittent compressions caused by transverse strains forces which, under the conditions, cannot but tend to effect it; and similarly with the requirement for a downward current and the production of a downward current.

Among the inductive proofs we find a kindred agreement. Different individuals of the same species, and different parts of the same individual, do strengthen in different degrees; and there is a clearly traceable connexion between their strengthenings and the intermittent strains they are exposed to. This evidence, derived from contrasts between growths on the same plant or on plants of the same type, is enforced by evidence derived from contrasts between plants of different types. The deficiency of woody tissue which we see in plants called succulent, is accompanied by a bulkiness of the parts which prevents any considerable oscillations; and this character is also habitually accompanied by a dwarfed growth. When, leaving these relations as displayed externally, we examine them internally, we find the facts uniting to show, by their agreements and differences, that between the compression of the sap-canals and the production of wood there is a direct relation. We have the facts, that in each plant, and in every new part of each plant, the formation of sap-canals precedes the formation of wood; that the deposit of woody matter, when it begins, takes place around these sap-canals, and afterwards around the new sap-canals successively developed; that this formation of wood around the sap-canals takes place where the coats of the canals are demonstrably permeable, and that the amount of wood-formation is proportionate to the permeability. And then that the permeability and extravasation of sap occur wherever, in the individual or in the type, there are intermittent compressions, is proved alike by ordinary cases and by exceptional cases. In the one class of cases we see that the deposit of wood round the vessels begins to take place when they come into positions that subject them to intermittent compressions, while it ceases when they become shielded from compressions. And in the other class of cases, where, from the beginning, the vessels are shielded from compression by surrounding fleshy tissue, there is a permanent absence of wood-formation.

To which complete agreement between the deductive and inductive inferences has to be added the direct proof supplied by experiments. It is put beyond doubt by experiment that the liquids absorbed by plants are distributed to their different parts through their vessels—at first by the spiral or allied vessels originally developed, and then by the better-placed ducts formed later. By experiment it is demonstrated that the intermittent compressions caused by oscillations urge the sap along the vessels and ducts. And it is also experimentally proved that the same intermittent compressions produce exudation of sap from vessels and ducts into the surrounding tissue.

That the processes here described, acting through all past time, have sufficed of themselves to develope the supporting and distributing structures of plants, is not alleged. What share the natural selection of variations distinguished as spontaneous has had in establishing them, is a question which remains to be discussed. Whether acting alone natural selection would have sufficed to evolve these vascular and resisting tissues, I do not profess to say. That it has been a cooperating cause, I take to be self evident: it must all along have furthered the action of any other cause, by preserving the individuals on which such other cause had acted most favourably. Seeing, however, the conclusive proof which we have that another cause has been in action—certainly on individuals, and, in all probability, by inheritance on races—we may most philosophically ascribe the genesis of these internal structures to this cause, and regard natural selection as having here played the part of an accelerator.

EXPLANATION OF PLATE LIV.

Fig. 1. Absorbent organ from the leaf of *Euphorbia neriifolia.* The cluster of fibrous cells forming one of the terminations of the vascular system is here imbedded in a solid parenchyma.

Fig. 2. A structure of analogous kind from the leaf of *Ficus elastica.* Here the expanded terminations of the vessels are imbedded in the network parenchyma, the cells of which unite to form envelopes for them.

Fig. 3. Shows on a larger scale one of these absorbents from the leaf of *Panax Lessonii.* In this figure is clearly seen the way in which the cells of the network parenchyma unite into a closely-fitting case for the spiral cells.

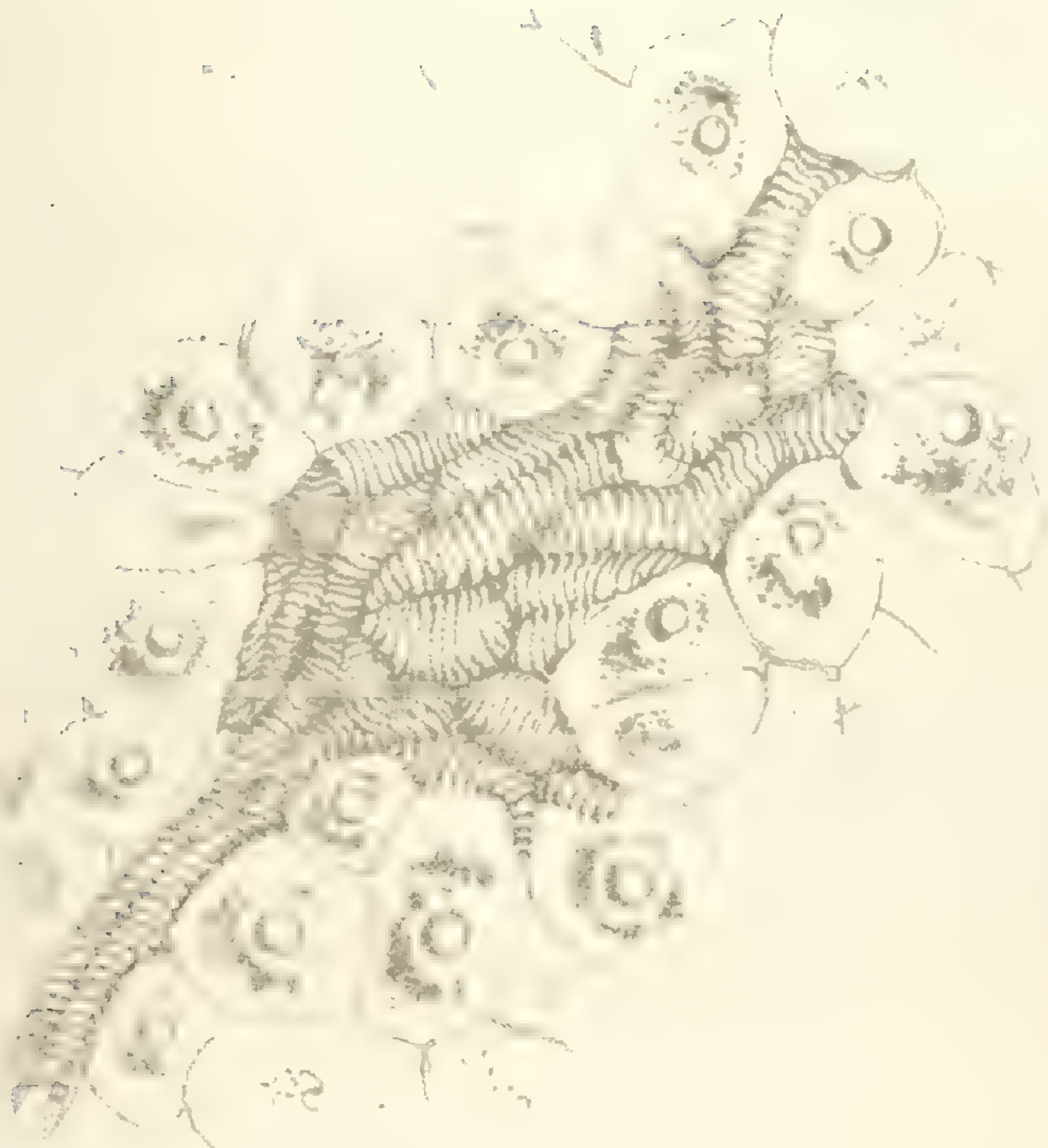
Fig. 4. Represents a much more massive absorbent from the same leaf, the surrounding tissues being omitted.

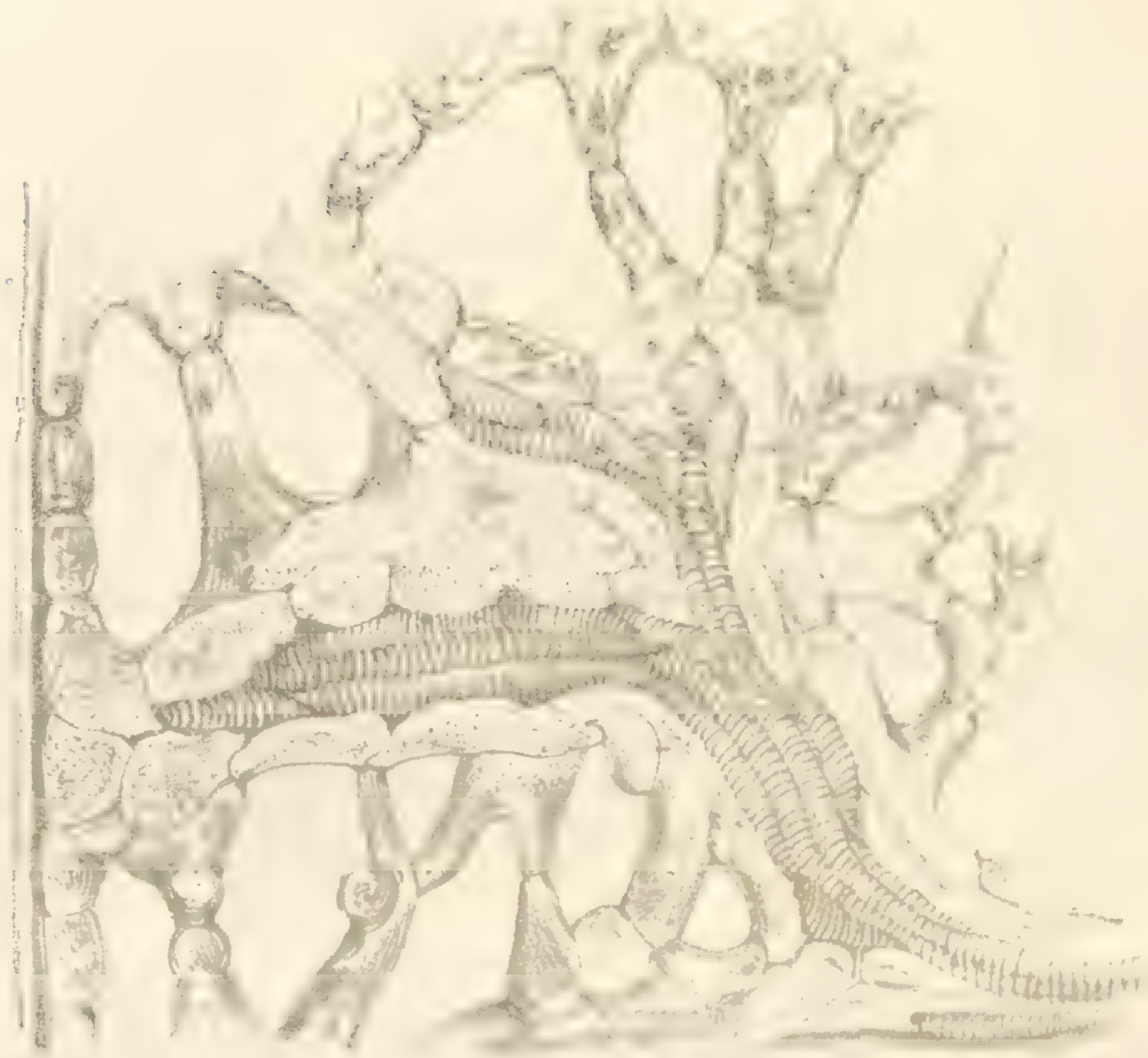
Fig. 5. Similarly represents, without its sheath, an absorbent from the leaf of *Clusia flava.*

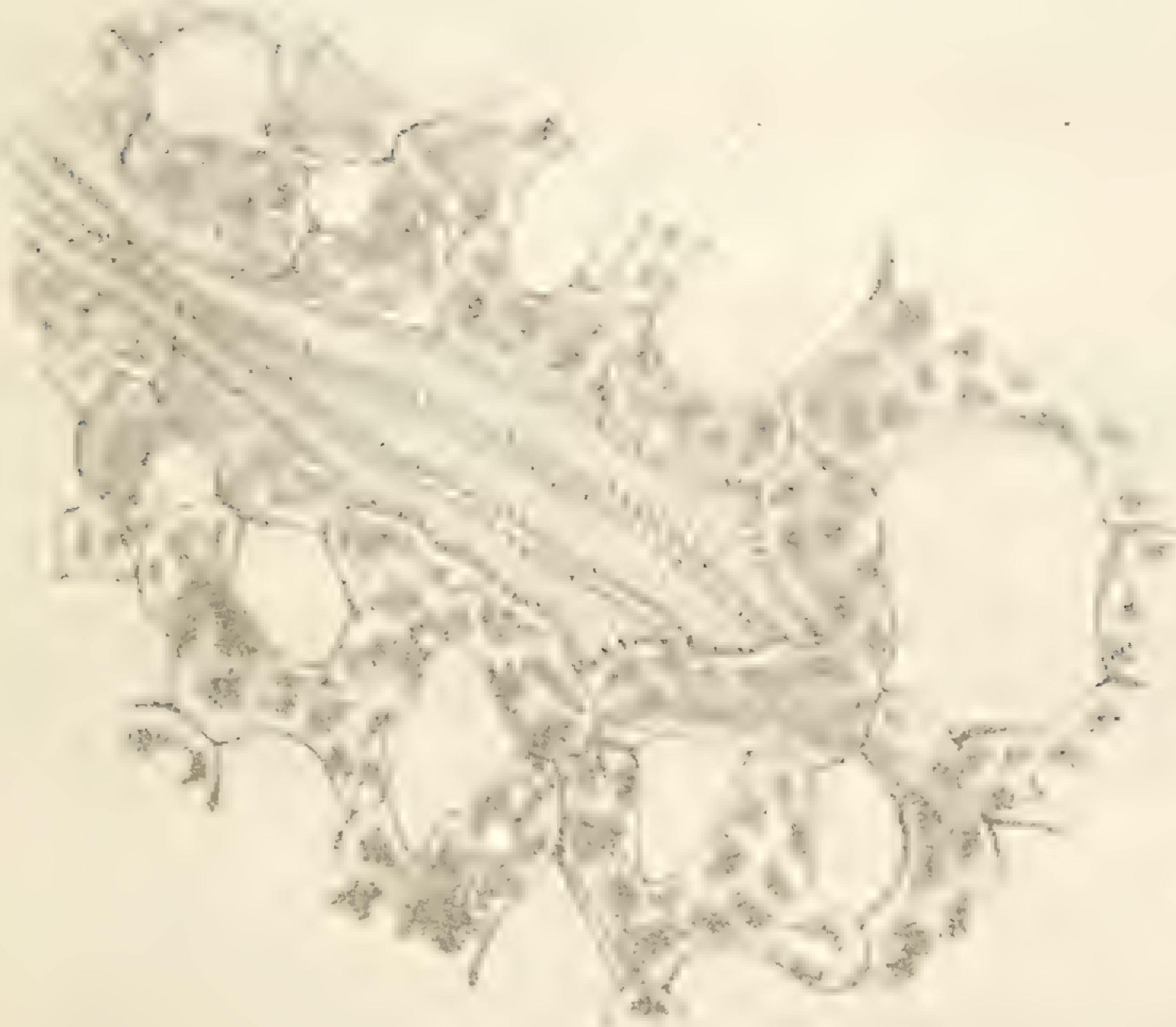
Fig. 6. End view of an absorbent organ from the root of a Turnip. It is taken from the outermost layer of vessels. Its funnel-shaped interior is drawn as it presents itself when looked at from the outside of this layer, its narrow end being directed towards the centre of the Turnip.

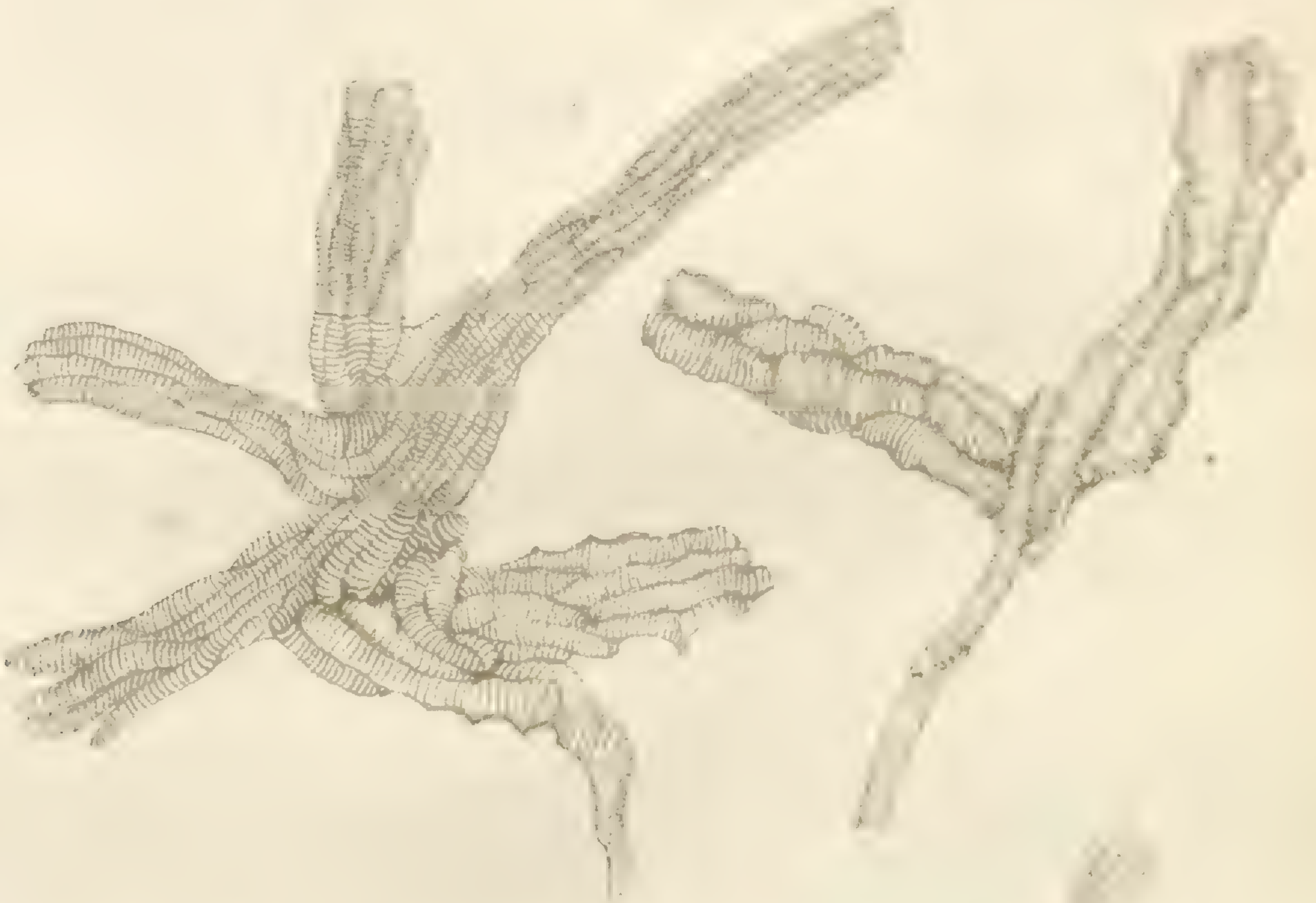
Fig. 7. A longitudinal section through the axis of another such organ, showing its annuli of reticulated cells when cut through. The cellular tissue which fills the interior is supposed to be removed.

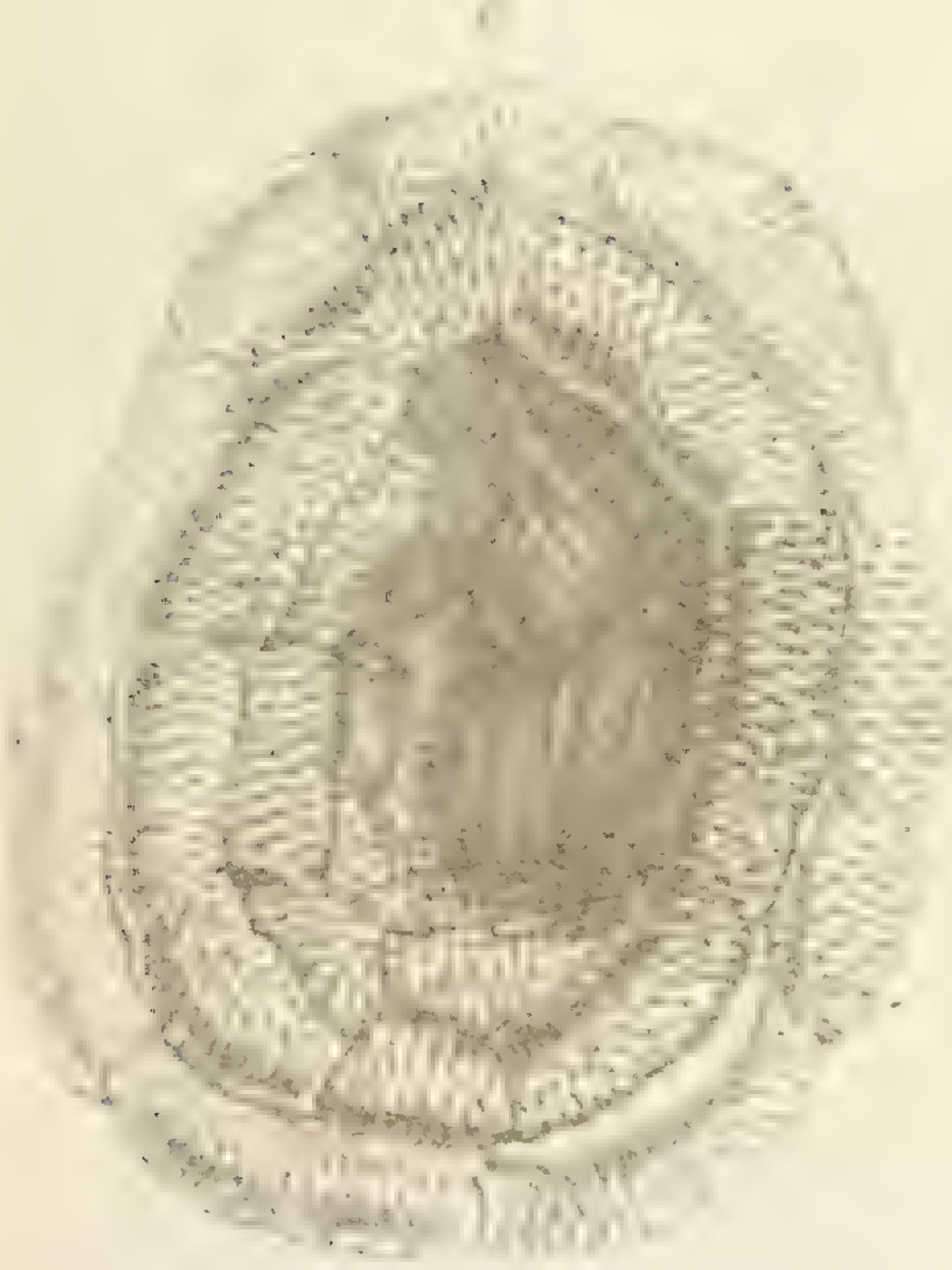
Fig. 8. A less-developed absorbent, showing its approximate connexion with a duct. In their simplest forms, these structures consist of only two fenestrated cells, with their ends bent round so as to meet. Such types occur in the central mass of the Turnip, where the vascular system is relatively imperfect. Besides the comparatively regular forms of these absorbents, there are forms composed of amorphous masses of fenestrated cells. It should be added that both the regular and irregular kinds are very variable in their numbers: in some turnips they are abundant, and in others scarcely to be found. Possibly their presence depends on the age of the Turnip.

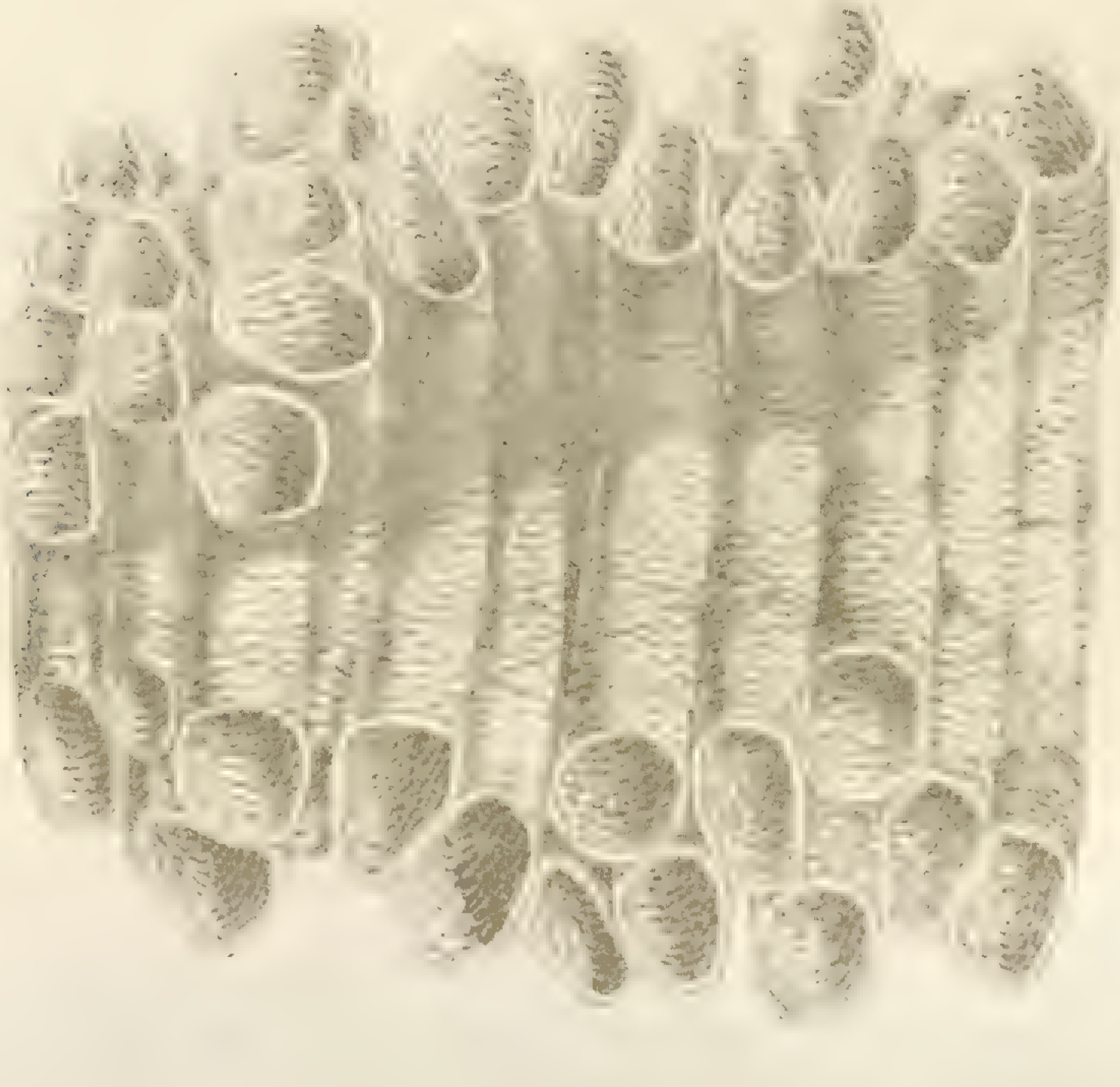


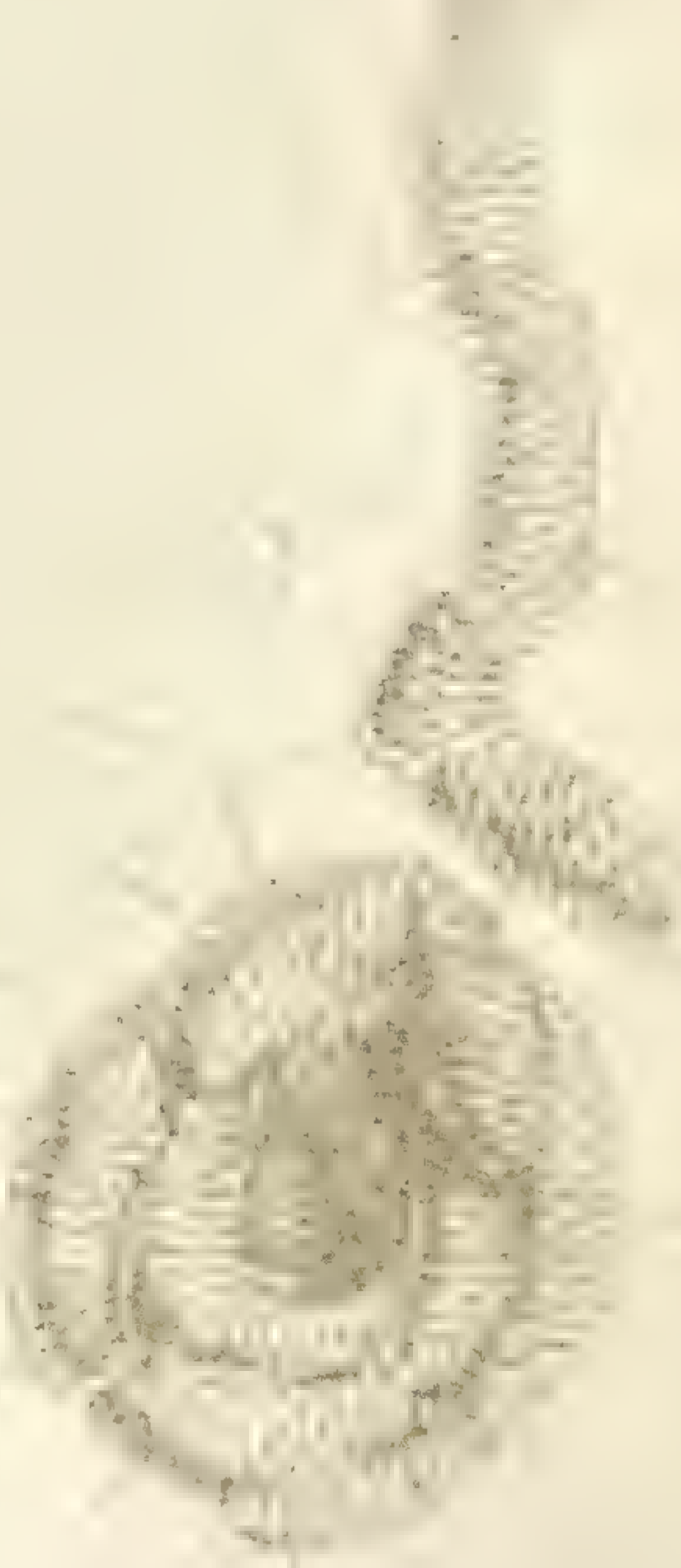












Herbert Spencer, del. Fitch, lith.

[illegible]

XVI. *On two New British Fungi.* *By the Rev.* M. J. BERKELEY, *M.A., F.L.S.*

(Plate LV.)

Read April 5th, 1866.

IN January last I received from Mrs. Holme Sumner, of Great Bookham, Surrey, a notice of a beautiful Fungus which was then growing abundantly under a Cedar tree in the neighbouring park at Fetcham; and numerous specimens were sent to me on the 12th of February. As it is of peculiar interest, from its appearing so early in the year, as well as from its very close relation to one figured by Bulliard, which has not recently occurred to any mycologist either in this country or on the continent, I venture to submit a drawing and short notice of it to the Linnean Society. Though hitherto unrecorded in our flora, it has been observed by Mrs. Sumner for many years, always appearing in the same spot and at the same early season.

Peziza lanuginosa, Bulliard, tab. 396. fig. 2, is referred by Fries as a variety to *Peziza hemisphærica*; but its broad, barren, colourless, distinct margin and large size seem to separate it, not to mention its reflected border. The species of which I now present a drawing agrees exactly with it in colour and clothing; but the trace of anything like a barren margin is comparatively very faint, there being nothing more than a slight groove, which is only visible under a magnifier, but when so seen is sufficiently distinct. It attains a much larger size, and is distinguished from both *Peziza hemisphærica* and *Peziza lanuginosa* by the cup splitting at an early stage of growth into several large segments, which are at length so deeply separated that the fungus looks like the outer peridium of a *Geaster*. Its close affinity with the genus *Hydnocystis* of Tulasne, like which it is at first almost subterraneous, is very striking; but the hymenium in that genus is never perfectly exposed, and the structure of the wall is somewhat different. In *Hydnocystis* the threads which clothe the surface are quite the same, and spring from little warts; but the whole of the substance beneath the hymenium is vesicular, the outer vesicles being darker-coloured, while in our *Peziza*, between the hymenium and outer layer, there is a thick stratum consisting of threads whose joints are often swollen, or the articulations constricted. The fruit of the *Peziza* is highly developed, and agrees very nearly with that of *Peziza hemisphærica*. The paraphyses are slightly branched, with clavate tips, the asci cylindrical, each containing a single row of broadly fusiform sporidia from $\frac{1}{1000}$ to $\frac{1}{700}$ of an inch long, and $\frac{1}{2000}$ to $\frac{1}{1666}$ broad, and containing one or two large nuclei, with a number of minute globules. In *Peziza hemisphærica* the sporidia are more obtuse, and about $\frac{1}{1000}$ of an inch long. The pointed ends are a very uncommon feature in the genus *Peziza*. I have never seen a specimen of *Peziza lanuginosa*, and can therefore say nothing about its fruit; but the present fungus is most probably only a variety of that species, altered a little in external appearance from its being so much immersed in the soil. The hymenium is at first white, but changes to cream-colour, or to a slight shade of tawny, in decay.

There is a *Peziza*, figured by Jacquin in the 'Miscellanea Austriaca,' with a very similar habit, which is referred by Fries to *Peziza repanda*, but which is probably nearly related to the present fungus.

The variety may be thus characterized:—

PEZIZA LANUGINOSA, Bulliard.

Var. *Sumneri*, Berk. & Br., cupula subhypogæa globosa profunde fissa.

The species has been observed in abundance since the above date by Mr. Edmonds under Cedars at Chiswick House, and by Mr. W. Wilson Saunders under a Larch near Reigate.

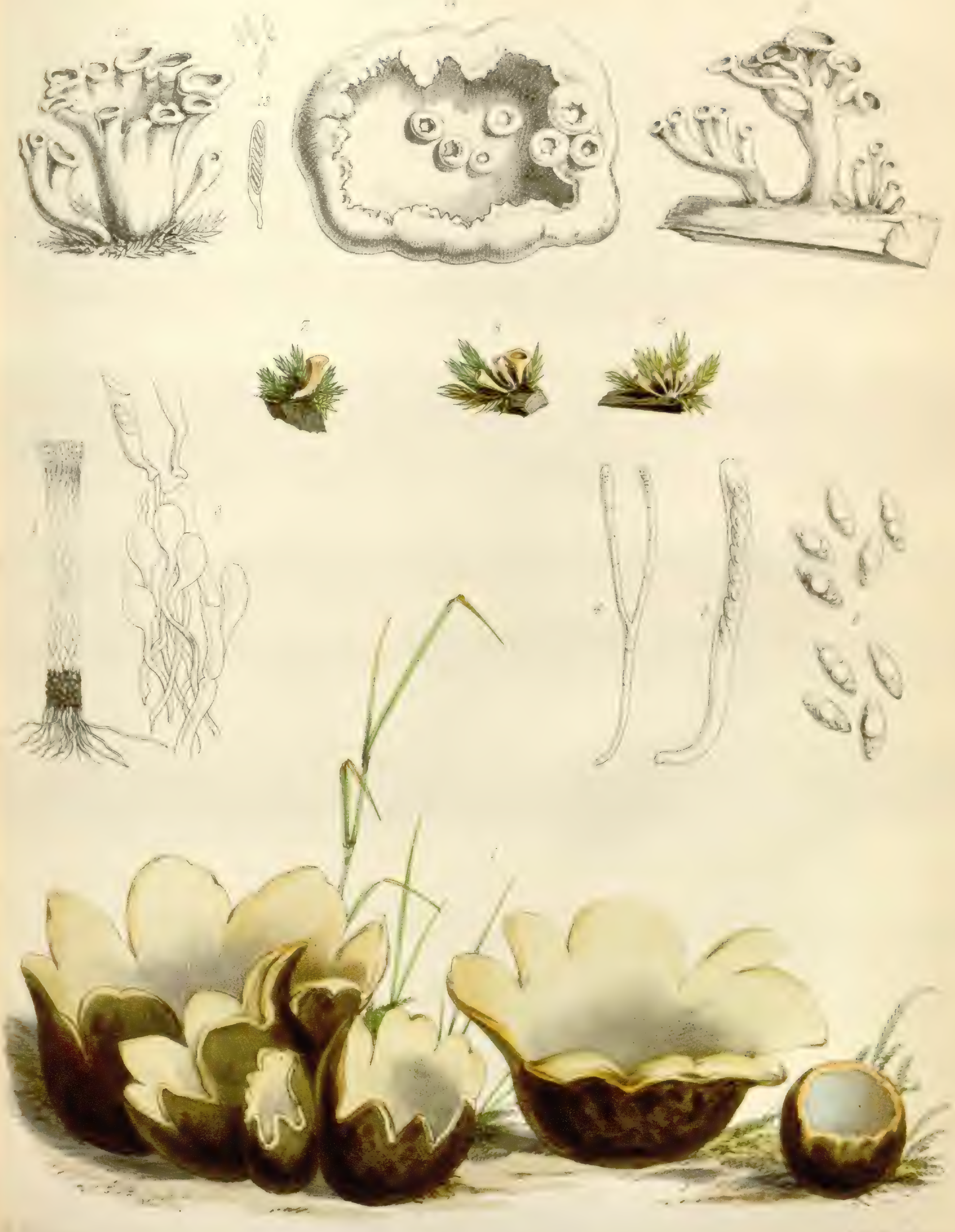
The second fungus to which I wish to call the attention of the Society is a *Peziza*, which appears to be identical with *P. pygmæa* Fr., and is remarkable for the extraordinary varieties of form which it exhibits. Figs. 7, 8, and 9 (Plate LV.) show the natural size and normal form of the plant, which has been found by Mr. Broome at Ascot and Wimbledon in Surrey, and on the Blackdown Hills near Taunton. Figs. 10 and 11 represent proliferous forms magnified. Fig. 12 is a more highly magnified figure of one of the cups of fig. 10; and fig. 13 represents the fruit, which is the same in the proliferous as in the normal form. Mr. Broome's notes of the Blackdown plants are as follows:—

"Stipitate about $\frac{1}{4}$ inch high, the stem often splitting or branching out into several divisions, each of which is terminated by a minute cup, giving the plant the appearance of a *Ditiola* or a *Tympanis*. Each of these cups produces other smaller cups on its surface; the branched and young cups resemble the genus *Solenia*. The colour of the mature plant was a bright apricot, whitish and tomentose at the base of the stem. It occurred in swampy places on rotten gorse, frequently coming through the ground, on mosses."

Mr. Broome informs me that in one of the Wimbledon specimens the surface of a cup was one mass of minute secondary cups, giving the plant almost the appearance of a small *Gyromitra*.

EXPLANATION OF PLATE LV.

Fig. 1. *Peziza lanuginosa*, var. *Sumneri*, natural size.
Fig. 2. Section through cup, slightly magnified.
Fig. 3. Filamentous portion of cup, more highly magnified.
Fig. 4. Branched paraphysis, ditto.
Fig. 5. Ascus, ditto.
Fig. 6. Sporidia, still more highly magnified.
Figs. 7, 8, 9. *Peziza pygmæa*, Fr., the normal form, natural size.
Figs. 10, 11. Proliferous forms of *P. pygmæa*, magnified.
Fig. 12. One of the cups of fig. 10, more highly magnified, showing the secondary cups.
Fig. 13. Fruit of *P. pygmæa*, magnified.



XVII. *Lichenes Amazonici et Andini lecti a Domino* SPRUCE.

By the Rev. W. A. LEIGHTON, *B.A., F.L.S.*

(Plate LVI.)

Read March 15th, 1866.

THE celebrated traveller Mr. Richard Spruce has entrusted to me a most magnificent collection of corticolar Lichens, formed by him during his long and laborious explorations in Equatorial America, for examination and determination. The result is comprised in the following catalogue, which contains not only very many rare and beautiful species already known, but also about twenty-four species previously unknown and undescribed. It is both a pleasure and a duty to acknowledge the liberality and kindness of Dr. Wm. Nylander, of Paris, in examining and confirming most of those which I consider to be new species,—a circumstance which will be duly appreciated by every lichenist who is acquainted with his great knowledge of exotic lichens—unsurpassed, indeed, by that of any living lichenologist.

In the list, I have added to the names certain numbers, which correspond with those on the tickets attached to the several sets of these lichens which have been distributed by Mr. Spruce, and by a reference to which their possessors will be now enabled to add the proper names. Many specimens (which were imperfect, from the attacks of insects and other causes) have been wholly omitted, and only those inserted which could be fully determined.

The following account of the region is in the words of Mr. Spruce himself:—

"I divide that part of Equatorial America explored by me into five great regions, depending on natural, and not on political features,—to wit:

"1. *The Lower Amazon* (from the mouth to the confluence of the Rio Negro, or about 1000 miles up).

"2. *The Rio Negro,* with its tributaries.

"3. *The Upper Orinoco* (*i.e.* above the cataracts).

"These first three regions are all in the Great Plain, which is perhaps nowhere elevated 1000 feet above the sea-level.

"4. *The Peruvian Andes.*

"5. *The Quitenian Andes.*

"As so many of my plants were gathered on the uncertain frontiers of limitrophous countries (for instance, in the territory claimed by Brazil on the one hand, and by Venezuela and Nova Granada on the other, and also in the neutral ground between Peru and Ecuador), any political grouping of regions could only be very transitory."

To save repetition, Mr. Spruce's descriptions of the several localities are here given. The names between inverted commas are those on the tickets attached to the sets.

1. *Ad flumen Amazonum.*

"Paricatuba." Prærupta, *Paricatuba* dicta, in fl. Amazonum ripis supra Santarem.
"Punta de Paricatuba." Ad fl. Amazonum.
"Rio Aripecurú." Fl. Trombetas affluens.
"Igarapé dos Ramos." Alveolus fl. Amazonum sic dictus.
"Cachs. do R. Aripecurú." Cachoeiros = Cataractæ fl. Aripecurú fl. Trombetas affluentis.
"Rio Caipuru." Fluvius fl. Trombetas tributarius.
"Obidos." Villa ad fl. Amazonum.
"Santarem." Villa ad fl. Amazonum secus fluvii Tapajos ostia.
"Pará." Secus fl. Amazonum ostia.
"Maranon." The name given to the upper part of the Amazon in Peru.

2. *In regione fluvii Negro.*

"Fl. Pacimoni." Fl. Casiquiari confluens.
"Uanauaca." Situs infra fl. Negro cataractas.
"R. Uaupés." Fl. fl. Negro confluens.
"Barra do Rio Nigro," *vel* "Manáos." Villa secus fl. Negro ostia, hodie *Manáos* nuncupata.
"Montaña de Javita." Sylva primæva ad origines fl. Negro et Atabapo.
"Rio Guainia" = fl. Negro superior. (The upper part of the Rio Negro, viz. above the confluence of the Casiquiari, is called the Guainia.)
"Umirisál." Campus arenosus fruticibus sparse vestitus, sic dictus, paullo supra fl. Negro ostia. (*Cladoniæ* grow on this hot plain, precisely as Rein-deer Moss grows on cold northern moors.)
"Caño Uaiauáca." Rivulus ad caput fl. Pacimoni fl. Casiquiari confluentis.
"Tarumá." Rivulus fl. Negro secus ejus ostia confluens.
"São Gabriel." Villa et cataracta fluvii Negro.
"San Carlos." Pagus fl. Negro superioris.
"Rio Negro." Fl. cum fl. Amazonum confluentis.
"Caatingas" = sylvæ humiliores sparsiores sic dictæ. (The general name for certain tracts of low sandy forest over granite on the Rio Negro.)
"Marabitanos." Pagus fl. Negro superioris. (The frontier village of Brazil.)
"R. Janauari." Janauari fl. ostiis, fl. Negro confluentis.
"Guia." Pagus fl. Negro superioris.
"Casiquiari." Casiquiari fl. (The natural canal that unites the Orinoco to the Rio Negro, rendered celebrated by the travels of Humboldt.)
"Catanacunámi." Situs fl. Negro superioris.
"Panuré." Pagus fl. Uaupés.

3. *Ad Flumen Orinoco.*

"Maypures." Cataractæ fl. Orinoci sic dictæ.
"Esmeralda." Pagus ad fl. Orinocum superiorem.

"Cerro del Mono." Mons graniticus paullo supra fl. Orinoci cataractas. (Lichens at the height of 1400′.)

"Casiquiari." Casiquiari fl. (The natural canal that unites the Orinoco to the Rio Negro, rendered celebrated by the travels of Humboldt.)

4. *Andes Peruviani.*

"Guayrapurina." Mons alt. 3500′ in Andibus Peruvianis.

"Tarapoto." Villa in Andibus Peruvianis orientalibus alt. 1500′.

"Lamas." Mons et villa Andium Peruvianorum, alt. 2000′.

"Campana." Mons in Andibus Peruvianis. (Lichens gathered at 3000′–5000′.)

"Yurimaguas." Pagus ad fl. Huallaga Peruviæ.

"Rio Chidicaio." Rivulus Chidicaio, vel melius Shillicaio, ad Tarapoto in Andibus Peruvianis.

5. *Andes Quitenses.*

"Chimborazo." Mons Andium Quitensium. (Lichens at 9000′–12,000′, and in Red-Bark woods at 3000′–6000′.)

"Antombós." Situs ad fl. Pastasa Andium Quitensium, alt. 5000′.

"Pallatanga." Vallis Andium Quitensium, alt. 6000′–7000′.

"Pangor." Vallis alpina (alt. 9000′–12,000′) Andium Quitensium.

"Montana de Canelos," *i. e.* sylva Canelos in radicibus orientalibus Andium Quitensium. (Lichens at 2000′–6000′.)

"Agoyán." Cataracta fl. Pastasa Andium Quitensium, alt. 5000′

"Abitagua." Mons Andium Quitensium, alt. 6000′.

"Guano" (sometimes Huano). Villa ad pedem or. montis Chimborazo, alt. 9000′.

"Playa del Pastasa." Litora fl. Pastasa Andium Quitensium, alt. 1500′, fruticetis Myrtacearum et Myricarum ornata.

"Tunguragua." Mons vulcanicus Andium Quitensium. (Lichens gathered at from 6000′–12,000′.)

"Baños." Pagus ad pedem montis Tunguragua, alt. 6000′.

"Rio Verde." Fluvius cum fl. Pastasa confluens, alt. 4000′, in Andibus Quitensibus.

"Guayrapata." Mons nemorosus Andium Quitensium. (Lichens at 9000′.)

"Vascún" (*vel* Baccún). Rivulus aquæ tepidæ in m. Tunguragua Andium Quitensium.

"Playa del Rio Blanco." Litora rivuli *Blanco* ad fl. Pastasa, alt. 5500′.

"Carguairazo." Mons nivosus Andium Quitensium. (Lichens gathered at 11,000′–12,000′.)

"Titaicún." Mons Andium Quitensium prope Riobomba. (Lichens at 11,000′ [cortical], to 13,000′ [rupestral].)

"Pichincha." Mons vulcanicus Andium Quitensium. (The city of Quito stands at its foot. Lichens at 10,000′–11,000′.)

"Parana." Merely the Indian name for river—it never occurs alone.

The following tabular arrangement will afford a comparative idea of the Lichens of various regions of South America :—

	Lich. Amaz. et Andini. (Spruce.)	Guyana*.	Nova Granada*.	Chili*.	Peruv. Boliv*.
Lichinei	0	1	0	0	0
Collemei	14	5	13	12	12
Myriangei	0	0	1	1	0
Caliciei	0	0	2	1	1
Tylophorei	0	0	2	0	0
Sphærophorei........	0	0	1	4	0
Bæomycei	0	0	4	2	2
Cladoniei	15	2	8	16	11
Stereocaulei	4	0	6	3	7
Roccellei............	0	0	0	4	3
Siphulei	0	0	2	2	3
Usneei	6	0	5	4	3
Ramalinei	3	2	3	14	12
Cetrariei............	0	0	1	3	1
Peltigerei	2	0	4	6	4
Parmeliei	59	8	42	38	47
Gyrophorei..........	0	0	0	2	9
Pyxinei	3	1	2	1	1
Lecanorei	29	27	69	47	57
Lecidiei	22	25	41	33	46
Graphidei	48	60	100	23	61
Pyrenocarpei	40	58	43	101	26
Total.........	245	189	349	317	306

Leptogium, Fr., Mnt., Nyl.

1. L. foveolatum, Nyl. (No. 2 †.)

Tunguragua.

Spores, see Plate LVI. fig. 1.

2. L. reticulatum, Mnt. (No. 3.)

Mons Abitagua.

This specimen agrees generally with the description given by Montagne and Nylander; but not having seen an authentic specimen, I refer it with some slight doubt. Neither Montagne nor Nylander have seen the spores, which in our plant are 8, colourless, cylindricofusiform, 5-septate; paraphyses thick and compact; the aqueous solution of iodine renders the asci and paraphyses blue, the spores yellow. See Plate LVI. fig. 2. Dr. Nylander thinks that *L. reticulatum*, Mnt., may be only a state of his *L. foveolatum*; but if I am correct in my determination, the spores and structure show it to be a good and distinct species.

3. L. tremelloides, Fr. 4; forma *laciniatum*, Tuck.=Wright's Lich. Cubæ, 16. (No. 4.)

San Carlos; Caatingas; Caño Uaiauáca; Panuré.

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* The numbers in these columns are taken from Dr. Nylander's writings in *Ann. Sc. Nat.* and his *Enum. Gen.*

† The numbers within brackets are those on the tickets attached to the distributed sets.

4. L. TREMELLOIDES, Fr., var. *azureum* (Mont.)=forma *macrophyllum*, Tuck., Wright's Lich. Cubæ, 14. (Nos. 6, 126.)

São Gabriel; Tarapoto; Obidos; Rio Aripecurú.

I have, in my herbarium, specimens of this plant gathered on some former occasion by Mr. Spruce at "Carissi, Pará," given to me by the Rev. Prof. Churchill Babington.

5. L. TREMELLOIDES, Fr., var. *marginellum*, Nyl. Syn. 125 = Wright's Lich. Cubæ, 7; Mont. Cuba, t. vi. f. 2. (Nos. 5, 1.)

Yurimaguas; Tarapoto.

No. 1, from Tarapoto, has typical and marginal apothecia.

6. L. DIAPHANUM, Mnt. = Lindig. Lich. Novæ Granatæ, 86. (No. 7.)
Thallus minutely impresso-punctate.

7. L. MENZIESII (Ach.). (No. 125.)

Rio Verde.

8. L. BULLATUM (Ach.) = Lindig. Lich. N. Gran. 118. (No. 9.)

Rio Verde; Chimborazo; Rio Blanco.

Spores 8, elliptical, pointed at the ends, murali-divided, about five divisions, colourless; iodine turns them blue.

9. L. PHYLLOCARPUM (Pers.) = Lindig. Lich. N. Gran. 48. (No. 13.)

Rio Verde; Yurimaguas.

10. L. PHYLLOCARPUM (Pers.), var. *macrocarpum*, Nyl. = Lindig. Lich. N. Gran. 87. 126. (Nos. 11, 14.)

Rio Verde; Lamas; Campana; San Carlos.

11. L. PHYLLOCARPUM (Pers.), var. *dædaleum*, Nyl. (Nos. 12, 14.)

Rio Verde; Yurimaguas.

Spores 8, colourless, 5-septate, murali-divided, elliptical.

12. L. BURGESSII, Mnt. (No. 8.)

Guayrapata.

COLLEMA, Ach. Nyl.

13. C. BYRSINUM, Ach. = Wright's Lich. Cubæ, 5. (No. 16.)

Taruina.

My herbarium contains an identical specimen collected by Mr. Spruce in 1849 at

"Carissio prope Pará," and labelled "*C. Boryanum*, Pers., determ. Bab. & Montagne, *Collema atro-crinitum*, Tayl.! in Hook. hb." Received from Prof. Churchill Babington.

HETERINA, Nyl.

14. H. TORTUOSA (Nees). (Nos. 840, 841.)

Moist granite rocks near San Isabel, R. Orinoco.

CLADONIA, Hoffm.

15. C. CERATOPHYLLA, Eschw. = Wright's Lich. Cubæ, 25. (No. 151.)

Campana.

16. C. VERTICILLARIS, Mont. (No. 29.)

Andes.

17. C. CHLOROPHÆA, Ach. (No. 28.)

Playa del Pastasa.

18. C. SANTENSIS, Tuck. (No. 26.)

Santarem.

19. C. RANGIFERINA, Hoffm., forma *sylvatica*. (No. 17.)

Umirisál.

20. C. PELTASTA, Spr. (No. 25.)

Panuré.

21. C. MEDUSINA (Bor.) (Nos. 19, 20, 21, 22, 23, 24.)

Panuré; Umirisál; Banos; Catanacunámi.

22. C. AGGREGATA, Eschw. (No. 18.)

Campana.

23. C. SQUAMOSA, Hoffm. ? forma *simplex*. (Nos. 27, 37.)

Guainia; Obidos.

24. C. CORNUCOPIOIDES, Fr., forma *pleurota*, Flk. (No. 30.)

Panuré; San Carlos; Barr-Umirisál.

25. C. CORNUCOPIOIDES, Fr., forma prolifera, cortice granuloso. (No. 32.)

Barr-Umirisál.

26. C. CORNUCOPIOIDES, Fr., forma podetiis plus minus decorticatis, parcè pulverulentis, foliolis maximè exasperatis. (No. 31.)
San Carlos; Tarumá.

27. C. CORNUCOPIOIDES, Fr., forma prolifera, foliolosa. (No. 33.)
Barr-Umirisál.

28. C. MUSCIGENA, Eschw. (No. 34.)
Campana.

29. C. BELLIDIFLORA, Schær., var. *Hookeri*, Nyl. (Nos. 36, 38.)
Guainia; Catanacunámi.

STEREOCAULON, Schreb.

30. ST. RAMULOSUM, Ach. (No. 41.)
Titaicún; Playa del Pastasa.

31. ST. TOMENTOSUM, Fr. (Nos. 42, 43.)
Chimborazo; Carguairazo.

32. ST. TURGESCENS, Nyl. (No. 40.)
Tunguragua.

33. ST. NANODES, Tuck. (No. 44.)
Tarapoto.

USNEA, Hoffm.

34. U. BARBATA, Fr., forma *florida*, Fr. (No. 49.)
Maypures.

35. U. BARBATA, Fr., forma *hirta*, Fr. (No. 50.)
Esmeralda.

36. U. BARBATA, Fr., forma *ceratina*, Schær. (No. 54.)
Tunguragua; Campana.

37. U. BARBATA, F., forma *cornuta*, Flot. (No. 48.)
Lamas; Cerro del Mono.

38. U. LONGISSIMA ?, Ach. (No. 53.)
Lamas.

39. U. LÆVIS (Eschw.). (No. 51.)

Agoyán.

ALECTORIA, Ach. Nyl.

40. A. JUBATA, Ach. (No. 47.)

Tunguragua.

RAMALINA, Ach., Fr.

41. R. FRAXINEA, Fr. (No. 55.)

Titaicún.

42. R. RIGIDA, Mont. (No. 52.)

Lamas; Tarapoto.

PELTIGERA, Hoffm.

43. P. RUFESCENS, Hoffm. (No. 57.)

Guayrapata; Tunguragua.

44. P. SPURIA, D.C. (No. 56.)

Rio Verde; Carguairazo.

STICTINA, Nyl.

45. ST. COMETIA (Ach.). (No. 58.)

Campana; San Carlos.

46. ST. HUMBOLDTII (Hook.). (No. 59.)

Pichincha; Playa del Pastasa; Tunguragua; Rio Verde.

47. ST. TOMENTELLA, Nyl. (Nos. 75, 76, 78, 79.)

Pichincha; Tunguragua; Pallatanga; Guayrapata; Tarapoto.

48. ST. GYALOCARPA, Nyl. (Nos. 60, 82.)

Rio Verde; Tunguragua; Guayrapata.

49. ST. KUNTHII (Hook.). (No. 61, 87.)

Playa del Rio Blanco; Yurimaguas; Rio Verde.

50. ST. LENORMANDII (V. d. B.) (Nos. 62, 67, 86.)

Tunguragua; Playa del Rio Blanco; Yurimaguas; Cano Uanauáca; Rio Verde; Playa del Pastasa.

51. ST. TOMENTOSA (Sw.). (Nos. 64, 72, 73, 74, 84.)

Rio Verde; San Carlos; Playa del Rio Blanco; Tunguragua; Antombós; Playa del Pastasa.

52. ST. QUERCIZANS (Ach.), margine thalli isidioso. (Nos. 79, 85.)

Pangor; Guayrapata; Tunguragua; Lamas.

53. St. quercizans (Ach.), var. *damæcornifolia*, Tuck., forma obscurior, apotheciis ciliatis. (Nos. 69, 70, 73, 83.)

Panuré; Caatingas; Rio Verde; Montana de Canelos.

54. St. quercizans (Ach.), var. *damæcornifolia*, Tuck., forma pallidior, apotheciis ciliatis. (No. 68.)

Campana; Lamas.

55. St. quercizans (Ach.), var. *sinuosa*, Tuck., apotheciis ciliatis. (Nos. 65, 66.)

Barr-Umirisál; Lamas.

56. St. quercizans (Ach.), var. *damæcornifolia*, Tuck., apothecii margine maxima parte ciliato. (Nos. 108, 109, 88.)

Tarapoto; in sylvis fluv. Guainiæ; Rio Verde.

57. St. quercizans (Ach.), var. *Peruviana* (Del.). (No. 71.)

Tunguragua.

58. St. sylvatica (Linn.). (No. 77.)

Chimborazo.

59. St. filicina (Ach.). (No. 415.)

Tunguragua.

60. St. filicinella, Nyl. (No. 90.)

Tunguragua; Rio Verde.

61. St. ciliaris, Mnt. & V. d. B. (Nos. 80, 81.)

Guayrapata; Tunguragua; Antombós.

Sticta, Ach., Nyl.

62. St. laciniata (Ach.), var. *læviuscula*, Nyl.=Lindig. Lich. N. Gran. 84; Hoffm., Pl. Lich. t. 65. f. 3. (No. 844.)

San Carlos; Mons Guayrupurina.

63. St. laciniata (Ach.), forma typica=Lindig. Lich. N. Gran. 116. (Nos. 98, 103.)

Rio Verde; Tunguragua.

64. St. laciniata, Ach., forma dilatata, laciniis latioribus subtus pallidioribus, apotheciis sparsis. (Nos. 103, 104, 106.)

Tunguragua; Guayrapata.

65. St. laciniata, Ach., forma *recurva*, Leight.; thallo scrobiculato, laciniis angustioribus, marginibus recurvis, apotheciis submarginalibus. (Nos. 93, 94, 95.)

Tunguragua.

66. St. laciniata, Ach., forma *sinuosa*, Leight.; thallo sublævigato, laciniis angustioribus sinuoso-dissectis, apotheciis submarginalibus. (Nos. 107, 102.)

Guayrapata; Campana.

67. St. laciniata, Ach., forma *ciliata*, Leight.; thallo subscrobiculato, laciniis subdilatatis, marginibus sordide ciliatis, apotheciis marginalibus ciliatis. (Nos. 104, 107.)

Campana; Tunguragua.

68. St. laciniata, Ach., forma *verrucosa*, Leight.; thallo scrobiculato, laciniis mediocribus et angustioribus, marginibus ciliatis, apotheciis sparsis margine verrucoso-rugoso. (Nos. 99, 100, 101, 102, 107.)

Tunguragua; Rio Verde; Baños.

69. St. carpolomoides, Nyl. (Nos. 845, 105, 413. ?)

Guayrupurina; São Gabriel; Caatingas.

70. St. damæcornis (Sw.), Del. t. 9. f. 39.; Hoffm. Pl. Lich. f. 1. (No. 96.)

Guayrapata.

71. St. damæcornis (Sw.), var. *sinuosa*, Pers. (No. 97.)

Rio Verde.

72. St. latifrons, Rich., var. *Menziesii* (Hook.) (No. 92.)

Chimborazo.

73. St. aurata, Ach. (No. 91.)

Playa del Pastasa; ad fluv. Blanco ostia; Tunguragua; Baños.

Ricasolia, De Not., Nyl.

74. R. dissecta, Ach., forma laciniis thalli latioribus, margine apothecii minute dissecto. (No. 116.)

Lamas; Playa del Pastasa; Campana.

75. R. dissecta, Ach., forma laciniis thalli elongatis angustioribus, margine apothecii minute dissecto. (No. 116.)

San Carlos.

76. R. dissecta, Ach., forma marginibus apotheciorum coronatis membranaceis foliaceis laciniolis. (Nos. 114, 115.)

Campana; Tunguragua; Rio Verde.

77. R. CORROSA (Ach.), Del. St. t. 18. f. 67. (Nos. 119, 121, 122.)
Tunguragua; San Carlos; Lamas; Campana.

78. R. CRENULATA, Hook. = Lindig. Lich. N. Gran. 13. (Nos. 110, 117.)
Playa del Pastasa; Tarapoto; Tunguragua; Baños; Guayrapata; Rio Verde.

PARMELIA, Ach., Nyl.

79. P. SPHÆROSPORA, Nyl. (No. 130.)
Maypures in montibus, ad Palmarum truncos.

80. P. MEGALEIA, Nyl. (No. 113.)
Santarem.

81. P. PERLATA, Ach. (No. 127.)
São Gabriel; San Carlos.

82. P. LATISSIMA, Fée, = Wright's Lich. Cubæ, 67: Fée, Suppl. t. 38. f. 4. (No. 112.)
Santarem; Lamas; Maypures; Obidos; São Gabriel.

83. P. APPENDICULATA, Fée, Suppl. t. 38. f. 3. (No. 118.)
Tarapoto.

84. P. TILIACEA, Ach. (Nos. 111, 159.)
Santarem; Cerro del Mono.

85. P. TILIACEA, Ach., var. *sublævigata*, Nyl. = Lindig. Lich. N. Gran. 110. (Nos. 136, 156.)
Maypures; Santarem.

86. P. LÆVIGATA, Ach., var. *sinuosa* (Sw.). (Nos. 132, 176.)
Tunguragua.

87. P. CERVICORNIS, Tuck. (No. 174, 175.)
Titaicún; Tunguragua.

88. P. RELICINA, Fr. (No. 136.)
Santarem.

89. P. RELICINA, Fr., var. *coronata*, Nyl. Syn. 386; Fée, Ess. t. 31. f. 2. (No. 158.)
Cerro del Mono.

90. P. KAMTSCHADALIS, Eschw. (Nos. 168, 166, 169.)
Tunguragua; Carguairazo; Baños.

Physcia, Nyl.

91. **Ph. flavicans**, D.C. (No. 171.)
Tunguragua.

92. **Ph. acromela**, Pers. (No. 172.)
Lamas.

93. **Ph. chrysophthalma**, D.C. (No. 173.)
Baños.

94. **Ph. leucomela**, Michx. (No. 170.)
Campana.

95. **Ph. leucomela**, Michx., forma *hypoxantha*, Tuck., "subtus nunc pallide flavicans," =Wright's Lich. Cubæ, 85. (No. 167.)
Lamas.

96. **Ph. comosa** (Eschw.). (No. 178.)
Playa del Pastasa.

My herbarium contains an identical specimen received from Prof. De Notaris, labelled "Serra dos Orgaos Brasil. rariss. legit Casaretto 1839."

97. **Ph. spèciosa** (Wulf). (No. 154.)
Tarapoto; Rio Verde.

98. **Ph. speciosa** (Wulf), var. *hypoleuca*, Ach.=Wright's Lich. Cubæ, 80. (Nos. 152, 153.)
Lamas; Tarapoto; M. Guayrapurina; Rio Verde; Campana.

99. **Ph. speciosa** (Wulf.), var. *isidiophora* (*Parmelia granulifera*, Ach. Syn. 212), marginibus laciniarum granuliferis vel isidiosis atque margine receptaculari minute isidiosè diviso. (Nos. 143, 177.)
Vascum; Maypures.

100. **Ph. speciosa** (Wulf), var. *podocarpa* (Bel.) = Wright's Lich. Cubæ, 82. (No. 165.)
Lamas; Campana.

101. **Ph. picta** (Sw.) = Wright's Lich. Cubæ, 91. (Nos. 164*, 191.)
Forest near Pará; Punta de Paricatuba.

Physcidia, Tuck, Obs. Lich.

102. **Ph. Wrightii**, Tuck. = Wright's Lich. Cubæ, 92. (No. 120.)
Lamas; Campana.

103. PH. SQUAMULOSA, Tuck. = Wright's Lich. Cubæ, 93. (Nos. 220, 200, 224.)
San Carlos; Catacunami; Santarem.

PYXINE, Fr.

104. P. COCOËS (Sw.). (Nos. 182, 183.)
Tarapoto.

105. P. COCCIFERA (Fée). (No. 137.)
Santarem.

106. P. MEISSNERI, Tuck. (Nos. 205, 155.)
Santarem; Rio Verde.

PANNARIA, Del., Nyl.

107. P. GAYANA (Mnt.).
Pichincha.

108. P. RUBIGINOSA, Del. (Nos. 180, 184, 134.)
Playa del Pastasa; Guayrapata; Tunguragua; Rivulus Chidicaio.

109. P. NIGRO-CINCTA (Mont.). (Nos. 141, 142, 181.)
San Carlos; Lamas; Campana; Tarapoto.

COCCOCARPIA, Pers., Nyl.

110. C. PARMELIOIDES (Hook., Mont.) = Wright's Lich. Cubæ, 104. (Nos. 139, 161.)
Esmeralda; San Carlos; Campana; Maypures.

111. C. PARMELIOIDES (Hook., Mont.) hypothallo insigniore nunc prominente = Wright's Lich. Cubæ, 105. (No. 179.)
Esmeralda.

112. C. PARMELIOIDES (Hook., Mont.), var. *erythrocardia*, Tuck. = Wright's Lich. Cubæ, 107. (No. 133.)
Rio Negro.

113. C. PARMELIOIDES (Hook., Mont.), var. *aurantiaca*, Nyl. N. Gran. = Wright's Lich. Cubæ, 106. (No. 129.)
San Carlos; Campana; São Gabriel; Yurimagnas; Vascun; Playa del Rio Blanco.

114. C. SMARAGDINA, Pers. (Nos. 157, 129, 138.)
Maypures (in montibus ad Palmarum truncos); rivulus Chidicaio; San Carlos.

115. C. stellata, Tuck. (Nos. 149, 148.)

Panuré; São Gabriel.

116. C. ciliolata, Mont. *Circinaria epiphylla*, Fée, Ess. t. 2. f. 12. (Nos. 631, 150, 233, 635, 486, 630, 550.)

San Carlos; Montaña de Javita; Panuré; São Gabriel; Barra do Rio Negro.

Erioderma, Fée.

117. E. unguigerum (Bor.). (No. 131.)

Tunguragua.

118. E. polycarpum, Fée. (Nos. 123, 124.)

Playa del Pastasa; Campana.

Cora, Fr.

119. C. Pavonia (Web.) = Lindig, Lich. N. Gran., 112. (No. 197.)

São Gabriel; Caatingas.

Dichonema, N. ab Esenb.

120. D. sericeum (Sw.). (Nos. 232, 234.)

Panuré; São Gabriel; San Carlos.

Amphiloma, Fr.

121. A. gossypinum (Mont.) = Wright's Lich. Cubæ, 110. (Nos. 140, 147.)

San Carlos.

Lecanora, Ach., Nyl.

122. L. Sprucei, Bab. (Nos. 598, 529, 494, 600, 530, 505, 427, 544, 597, 626.)

Barro do Rio Negro; Casigniare; São Gabriel; forest near Pará.

Identical with a plant on leaves, named as above, from Rev. Prof. Churchill Babington, but I know not where described.

123. L. dimidiata, Ach. (Nos. 470, 629, 557, 465, 539, 538, 498, 534, 536, 578, 566, 541, 436, 468, 435, 628.)

São Gabriel; Montaña de Javita; Panuré; Barra do Rio Negro; Uanauaca; San Carlos.

On leaves of various trees; identical with a specimen in my herbarium named as above, given to me by Rev. Prof. Churchill Babington, and collected by Mr. Spruce at Carissi, Pará. Spores 8, colourless, cylindrico-oblong, narrow, 3-septate, gelatina hymenea blue with iodine.

124. L. Parella, Ach., var. *pallescens*, Ach. (No. 193.)

Santarem.

125. L. SUBFUSCA, Ach., var. *allophana*. (No. 190.)

Santarem.

126. L. SUBFUSCA, Ach., forma. (No. 189.)

São Gabriel.

127. L. SOREDIFERA, Fée. (Nos. 189, 186, 163.)

São Gabriel; Rio Janauari; Marabitanas; Panuré.

128. L. ATRA, Ach. (Nos. 164, 842.)

Santarem; Baños.

THELOTREMA, Ach., Nyl.

129. TH. PLATYSTOMUM, Mont. (No. 251.)

Casiquiari; Punta de Paricatuba.

130. TH. OLIVACEUM, Mont. (Nos. 241, 249.)

Panuré; San Carlos.

131. TH. CAVATUM, Ach., forma *amplius*, Nyl.=Lindig, Lich. N. Gran. 99. (Nos. 270, 271.)

San Carlos.

132. TH. AUBERIANUM, Mont. (Nos. 268, 269.)

Santarem; Casiquiari.

133. TH. LEPADINOIDES, Leight.; thallus olivaceus, tenuis, opacus, leviter verrucoso-rugosus, lineâ angustâ nigrâ limitatus, verrucis sparsis orbicularibus hemisphæricis lævigatis, ostiolo mediocri, subdilacerato; margine proprio laterali nigro; margine thallino crassiusculo, disco pallido, aperto; sporæ 8, incolores, cylindrico-fusiformes, multicellulosæ, maximæ, iodo cærulescentes. (No. 245.)

Uanauaca.

Paraphyses graciles, distinctæ, confertæ. Gelatina hymenea iodo lutescens. Facie externa valde simile *Thel. lepadino*, Ach., tamen abunde differt structurâ internâ atque sporis. *Thelotrema lepadodes*, Tuck. Obs. 1862, differt sporis submurali-divisis.

TAB. LVI. fig. 3, spora aucta 1200.

134. TH. PERFORATUM, Leight.; thallus pallide olivaceo-virescens, cartilagineus, leviter verrucoso-rugosus, lineâ angustissimâ undulato-crenatâ rubro-nigrâ aquosè limitatus; apothecia immersa; ostiola minuta, numerosa, perforata; margine thallino crassiusculo, elevato, tumido, margine proprio integro, fusco, incurvato; discus fuscus, planus, margine proprio prominente conspicuè circumplexus; sporæ 8, incolores, elongato-ellipticæ, 10-cellulosæ, mediocres, iodo cærulescentes. (No. 254.)

Casiquiari.

Paraphyses graciles, distinctæ, valdè confertæ, iodo lutescentes. Admodum distinctum structurâ et sporis ab omnibus congeneribus facie externâ similibus.

TAB. LVI. fig. 4, spora aucta 1200.

135. TH. DEHISCENS, Leight.; thallus albido-olivaceus, crassus, leviter undulato-rugosus, areolato-rimosus, lineâ angustâ nigrâ limitatus; areolæ prominentes; tumidæ; apothecia omnino immersa in verrucis subhemisphæricis subdepressis confertis apice actino aut irregulariter dehiscentibus, et tunc albis leprosis; ostiola minuta, leprosè marginata; proprio margine crasso, et disco pallido; sporæ 6, incolores, elongato-oblongæ, 11-cellulosæ, magnæ. (No. 395.)

San Carlos.

Paraphyses graciles, valde confertæ, iodo fuscescentes. Sporæ iodo fuscescentes, tamen leviter cæruleè tinctæ. Accedens ad *Thelot. sphinctrinellum*, Nyl. N. Gran. 40, secundum descriptionem, tamen sporis aliisque characteribus satis distinctè diversum. Nec confundetur *Th. pachystomo*, Nyl. Lindig. Lich. N. Gran. 55, 88, cui sporæ parvæ, 4-loculares.

TAB. LVI. fig. 5, spora aucta 1200.

CŒNOGONIUM, Ehrnb.

136. C. LEPRIEURII, Mont.=Lindig. Lich. N. Gran., No. 114. (Nos. 227, 228, 230.)

Barra do Rio Negro; São Gabriel.

137. C. LINKII, Ehrnb. (Nos. 226, 229, 417.)

São Gabriel; Barro do Rio Negro; Tunguragua.

138. C. INTERPOSITUM, Nyl. (Nos. 837, 585, 476, 457, 491, 582, 599, 571, 533, 620, 625, 637, 559, 549, 537, 837.)

São Gabriel; Panuré; Barro do Rio Negro; San Carlos; Marabitanas.

139. C. CONFERVOIDES, Nyl. (No. 838.)

Panuré.

140. C. INTERPLEXUM, Nyl. (No. 231.)

San Carlos.

LECIDEA, Ach., Nyl.

141. L. RUSSULA, Ach. (Nos. 215, 216.)

Maypures; Santarem.

142. L. RUSSELLII, Tuck.? (No. 217.)

São Gabriel.

143. L. DECOLORANS, Flk. (No. 398.)

Tarapoto.

144. L. ANOMALA (Fr.). (No. 211.)

San Carlos.

145. L. PIPERIS (Spreng.). (Nos. 181, 218.)

Casiquiari; Marañon.

146. L. PIPERIS (Spreng.) = Wright's Lich. Cubæ, 190. (No. 160.)

Tarapoto.

147. L. PARVIFOLIA, Pers. (Nos. 225, 209, 219.)

San Carlos; Obidos.

148. L. PARVIFOLIA, Pers., var. *intermediella*, Nyl. = Wright's Lich. Cubæ, 183. (No. 208.)

São Gabriel.

149. L. PARVIFOLIA, Pers., var. *subgranulosa*, Tuck. = Wright's Lich. Cubæ, 185. (Nos. 210, 223.)

Santarem.

150. L. PARVIFOLIA, Pers., var. *subgranulosa*, Tuck. Transiens in statum corallinum. (No. 162.)

San Carlos.

151. L. PARVIFOLIA, Pers., var. *corallina*, Tuck. (Nos. 185, 221.)

Yurimaguas; San Carlos.

152. L. DISCIFORMIS (Fr.). (No. 397.)

Tarapoto.

153. L. MYRIOCARPA (D.C.) (corticola). (Nos. 207, 213, 214.)

Santarem.

154. L. MYRIOCARPA (D.C.) (lignicola). (No. 203.)

Pará.

155. L. TUBERCULOSA, Fée = Wright's Lich. Cubæ, 228. (No. 850.)

Lamas.

156. L. MICROPHYLLINA, Tuck., var. *subgranulosa*, Tuck. Approaching Wright's Lich. Cubæ, 214. (No. 212.)

São Gabriel.

157. L. TRIPHRAGMIA, Nyl.? (No. 851.)

In ramulis fl. Negro inundatis prope Guia.

GRAPHIS, Ach., Nyl.

158. GR. SCRIPTA, Ach. (Nos. 290, 311, 286? 287? 309?)

San Carlos; R. Janauari; Rio Negro.

Specimens too imperfect to decide positively, as no spores visible.

159. GR. SERPENTINA, Ach. (No. 339.)

San Carlos.

160. GR. CONNATA (Eschw.). (No. 328.)

San Carlos.

Dr. Nylander considers this to be *Oxystoma connatum*, Eschw. Brazil, p. 92.

TAB. LVI. fig. 10, spora aucta 1200.

161. GR. STRIATULA, Ach. (No. 315.)

Panuré.

161*. GR. STRIATULA, Ach., forma elongata, lirellæ maximè elongatæ, sporæ 8, incolores, 6-cellulosæ. (No. 406.)

In ramis emortuis ad confluentiam fl. Guianiæ et Casiquiari.

162. GR. CHRYSOCARPA, Eschw. (No. 318.)

Chimborazo.

163. GR. SUBSTRIATULA, Nyl. N. Gran. 53. (No. 335.)

R. Janauari.

164. GR. PELLETIERII, Fée. (No. 332.)

Punta de Paricatuba.

"Sporæ a cel. Fée erroneè indicantur."—*Dr. W. Nylander in litt.*

165. GR. SCALPTURATA, Ach., forma *plurifera*, Nyl. (=*pruinosa*, Mont.); sporæ incolores, iodo cærulescenti-obscuratæ, elongato-oblongæ, 10-cellulosæ, cellulæ semel longitudinaliter divisæ. (Nos. 324, 289, 295.)

Panuré; San Carlos; Tunguragua.

166. GR. SCALPURATA, Ach., forma *plurifera*, Nyl., sporæ 2–8, fuscescentes, iodo cærulescenti-obscuratæ, elongato-oblongæ, majores quam in præcedente, murali-divisæ. (Nos. 330, 274, 334.)

San Carlos; São Gabriel; Santarem.

167. GR. SCALPTURATA appears to be a very polymorphous species, both in external aspect and in the divisions and colour of the spores. A specimen from Dr. Montagne himself, collected at Cayenne, has the spores 8, small, oblong or subelliptical, 5-celled, colourless; whilst Lindig. Lich. N. Gran. 54 has one immense cylindrico-oblong fuscous murali-divided spore, more than three times longer than in our No. 330.

168. GR. POITÆI, Fée; perithecium omnino incolor, non carbonaceum; sporæ circa 4, latè oblongæ, murali-divisæ, seriebus 7–9–12 transversim loculosæ, loculæ 3–5 in quavis serie, iodo cærulescentes. (Nos. 293, 294, 404.)

São Gabriel; Obidos; Tarapoto.

169. GR. RIGIDA, Fée. (No. 327.)

San Carlos.

Specimina in statu imperfecto, sporis non visis, ergo determinatio incerta sit.

170. GR. AFZELII, Ach.=Lindig, Lich. N. Gran. 34. (Nos. 298, 299, 300, 301, 302.)

Santarem; San Carlos; Obidos; Punta de Paricatuba.

171. GR. ANGUSTATA, Eschw. Bras. p. 94; sporæ iodo vix tinctæ. (No. 322.)

San Carlos.

172. GR. CONDAMINEA? Fée, Ess. 30, t. ix. fig. 1; sporæ 6–8, incolores, lineari-oblongæ, 9-cellulosæ, iodo cærulescentes. (No. 317.)

São Gabriel.

173. GR. TENELLA, Ach. (Nos. 342, 344, 345, 280.)

San Carlos.

174. GR. ANFRACTUOSA, Eschw. Bras. p. 86. (No. 337.)

São Gabriel.

175. GR. DIVIDENS, Nyl. N. Gran. p. 58. (Nos. 343, 326, 283, 281.)

San Carlos.

176. GR. LEPRIEURII (Mont.). (No. 284.)

Santarem; San Carlos.

177. GR. ANGUILLIFORMIS, Tayl. (Nos. 292, 296.)

Santarem; Punta de Paricatuba; Casiquiari.

178. GR. ANGUILLIFORMIS, Tayl., forma *denudata*; sporæ 2–4–8, cylindrico-fusiformes, incolores, 18-cellulosæ, iodo cærulescentes; paraphyses distinctæ. (No. 316.)

São Gabriel.

179. GR. SAUROIDEA, Leight.; thallus albido-glaucescens, tenuis, effusus; lirellæ mediocres, emergentes, prominentes, simplices aut ramosæ, valde flexuosæ, utrâque extremitate curvatæ, atque ibidem sæpe breviter curvato-ramosæ; epithecio rimiformi, paulum hiascente, depresso, subpallide suffuso; margine proprio crasso, tumido, sæpe longitudinaliter obsolete striato; hypothecio carbonaceo, crasso, integro; margine thallino tenui, distincto; sporæ 6 aut 8, incolores, cylindricæ, 9–12-cellulosæ, maximæ, iodo cærulescentes. (No. 331.)

Obidos.

Lirellæ assimilantes formas minutarum lacertarum. Paraphyses graciles distinctæ.

TAB. LVI. fig. 7, spora aucta 1200.

180. GR. SUBVIRGINEA, Nyl. MS.; thallus pallidus, tenuis, subcrustaceus, opacus, lævigatus, lineâ angustâ atrâ limitatus; lirellæ mediocres, emergentes, plus minusve thallo obtectæ, simplices, valde undulato-flexuosæ, confertæ, sæpe fractæ; proprio margine tenui, subincurvato; epithecio rimiformi, clauso, deinde hiascente atque albo suffuso; hypothecio carbonaceo, integro; sporæ 8, incolores, mediocres, cylindricæ, circa 10-cellulosæ, iodo fuscescentes. (No. 341.)

Marabitanas.

Paraphyses graciles, distinctæ.

181. GR. SUBVIRGINEA, Nyl. MS., forma *denudata*, Leight.; lirellæ magis denudatæ quam in typo, valde confertæ atque confluentiâ radiato-ramosæ; sporæ similes typo. (No. 328 bis.)

San Carlos.

TAB. LVI. fig. 8, spora aucta 1200.

182. GR. DENDROIDEA, Leight.; thallus albo-glaucescens, membranaceus, tenuis, lævigatus, lineâ brunneâ limitatus; lirellæ emergentes, prominentes, vix thallo lateraliter basi tectæ, dendroideo-ramosæ, apicibus attenuatis; proprio margine subcrasso, obsoletè substriatulo; epithecio rimiformi; hypothecio carbonaceo, integro; sporæ 2, incolores, maximæ, cylindricæ, 13-cellulosæ, iodo cærulescentes. (No. 285.)

On bark of Bread-fruit trees, San Carlos.

TAB. LVI. fig. 9, spora aucta 1200.

183. GR. CYMBEGRAPHA, Leight.; thallus fusco-olivaceus, subcrustaceus, lævigatus, diffusus, lineâ angustâ undulatâ brunneâ limitatus; lirellæ fuscæ, nudæ, planæ aut concaviusculæ, erumpentes, apicibus obtusis, margine thallode tumescente cinctæ, magnitudine et formâ valde variabiles, oblongæ, rotundo-oblongæ, et lanceolato-lineares,

curvatæ et undulato-flexuosæ, simplices, raro semel ramosæ; margine proprio tenuissimo laterali, basi nudo; sporæ 8, maximæ, cylindrico-fusiformes, circa 22-cellulosæ, cellulis bi- ad trilocularibus, iodo cærulescenti-infuscatæ; paraphyses maximè confertæ, graciles, vix distinctæ. (Nos. 307, 319, 320, 321.)

Ad corticem *Pithecolobii* spec., Rio Negro; Casiquiari; Panuré.

Of this, Dr. W. Nylander writes in litt. "l'espèce la plus voisine est le *Gr. mesographa*, Nyl. (Prodr. N. Gran. p. 80). C'est un *Lecanactis* dans le sens de Montagne."

Tab. LVI. fig. 11, spora aucta 1200.

184. Gr. internigricans, Nyl. MS.; thallus albâ maculâ, lineâ nigrâ limitatâ, indicatus; lirellæ mediocres, emergentes, prominentes, thallo lateraliter basi obtectæ, simplices, rectæ aut undulatæ, subparallelæ, apicibus obtusis; proprio margine crasso, tumido; epithecio rimiformi, hiascente, nigro; sporæ 8, incolores, oblongæ, muraliter divisæ, seriebus circa 7 transversim loculosæ, loculæ 3–4 in quâvis serie; paraphyses valde graciles, distinctæ. (No. 329.)

San Carlos.

Tab. LVI. fig. 12, spora aucta, 1200.

185. Gr. Sprucei, Leight.; thallus galactino-albidus, effusus, crustaceus, rimoso-areolatus, lævigatus, circa lirellas tumidiusculus atque illas lateraliter investiens; lirellæ mediocres, erumpentes, subprominentes, simplices aut raro radiato-ramosæ; margine proprio crasso, incurvato, longitudinaliter striato, plus minusve thallo albo-suffuso; epithecio rimiformi; sporæ 8, muraliter divisæ, seriebus circa 8 transversim loculosæ, loculis 2–3 in quâvis serie, leviter fuscescentes. (No. 323.)

Pacimoni.

Of this, Dr. Nylander in litt. says, "C'est certainement une espèce nouvelle du groupe du *striatula*. 'The spirally twisted paraphyses,' cela dépendant d'une déformation accidentelle qui se rencontre souvent chez les *Graphis* et *Thelotrema*, et non-seulement pour les paraphyses, mais également pour les thèques, à savoir de se crisper ou d'onduler (non devenir 'spiraliformes,' comme vous le pensez). C'est un effet de compression."

I have named it after the illustrious and scientific traveller Mr. Richard Spruce, a respectful tribute to the enterprise and perseverance which have introduced to the scientific world a collection of tropical lichens unsurpassed.

Tab. LVI. fig. 13, spora aucta, 1200.

186. Gr. subnitida, Nyl. MS.; thallus olivaceus, subnitidiusculus, lævigatus, effusus; lirellæ rimiformi-erumpentes, graciles, elongatæ, flexuosæ, simplices vel radiato-ramosæ, innatæ, margine thallode tenui pallido ascendente cinctæ, intus incolores; sporæ 8, incolores, ovatæ vel oblongæ, muraliter divisæ, iodo lutescentes; paraphyses confertæ, distinctæ, validæ. (No. 291.)

Obidos.

Tab. LVI. fig. 14, spora aucta 1200.

187. Gr. fulgurans, Nyl. MS.; thallus pallide fuscus, diffusus, tenuis, lævigatus, margine brunneo aquoso limitatus; lirellæ graciles, angustæ, valde elongatæ, e centro divergentes, radiato-dendriticæ, ramosissimæ, apicibus obtusis, intus incolores; epithecio plano, nigro-fusco, margine thallode tenui crassiusculo ascendente cincto; sporæ 4, oblongæ, uno apice angustiores, 3-septatæ, fuscescentes, parvæ. (Nos. 288, 338.)

Ad corticem *Ingæ*, San Carlos; Rio Negro.

Ad stirpem *Medusularum* pertinens.

Tab. LVI. fig. 15, spora aucta 1200.

188. Gr. furfuracea, Leight.; thallus galactino-albidus, glaucescens, effusus, tenuis, membranaceus, lævigatus, subnitidiusculus, at circa lirellas recedens et ibidem sorediatus aut furfuraceus; lirellæ simplices, oblongæ et oblongo-lineares, apicibus obtusis, erumpentes, albo furfure suffusæ, intus incolores, epithecio rimiformi inconspicuo subhiascente; hypothecium incolor; sporæ 8, incolores, parvæ, ellipsoideæ, 4-loculares, iodo cærulescenti-obscuratæ; paraphyses confertæ, inconspicuæ. (No. 303).

San Carlos.

Ad stirpem *Fissurinarum* pertinens.

Tab. LVI. fig. 16, spora aucta 1200.

189. Gr. planetocarpa, Leight.; thallus galactino-albidus, crustaceus, crassiusculus, lævigatus, lineâ fusco-nigrâ limitatus; lirellæ erumpentes, prominentes, sessiles, gracillimæ, valde elongatæ, undulato-curvatæ, subgyrosæ et inter se confluentes; epithecio rimiformi; hypothecio carbonaceo, integro; sporæ 8, incolores, minimæ, ellipsoideæ, 4-loculares, iodo cærulescentes; paraphyses validæ, distinctæ. (No. 340.)

San Carlos.

Ad stirpem *Graphidis scriptæ* pertinens.

Tab. LVI. fig. 17, spora aucta 1200.

190. Gr. oryzoides, Leight.; thallus sordide olivaceus, crassiusculus, rimosus; lirellæ sparsæ, simplices, oblongæ aut elongato-oblongæ, leviter flexuosæ, prominentes, tumidæ, membranâ crassâ albo-pruinosâ vestitæ; epithecio profunde impresso, concolore; margine tumido, crassissimo, albo, plus minusve longitudinaliter striato, involvente perithecium laterale crassum fusco-nigrum; hypothecium infra incolor; sporæ 8, incolores, parvæ, oblongæ, 3–5-loculosæ, loculis nunc integris nunc nucleolatis, iodo subvinose lutescentes; paraphyses confertæ, validæ, distinctæ. (No. 297).

Santarem.

Ad stirpem *Graphidis frumentariæ* pertinens.

Dr. Nylander in litt. says, "Bonne nouvelle espèce; elle est voisine de l'*Afzelii*, mais avec des rapports avec les *Gr. triphora*, Nyl. (N. Gran. 2nd ed. p. 133), et *Gr. frumentaria*, Fée."

Tab. LVI. fig. 18, spora aucta 1200.

OPEGRAPHA, Ach.

191. O. VULGATA, Ach. (Nos. 276, 450, 462, 518.)

São Gabriel; Barra do Rio Negro: in foliis *Marantaceæ, Philodendri* sp., *Palmarum* et *Mangiferæ indicæ*.

192. O. PROSODEA, Ach. (Nos. 314, 272, 273.)

São Gabriel; Obidos; Uanauaca.

193. O. HYSTERIOSPORA, Leight.; thallus pallide sordidus, tenuis, diffusus; lirellæ lineares, gracilentæ, irregulariter radiato-ramosæ; epithecio rimiformi, demum aperto, marginato; hypothecium nigrum, integrum; sporæ 8, oblongæ, fuscæ, 3-septatæ. (No. 305.)

Ad corticem, São Gabriel.

TAB. LVI. fig. 19, spora aucta 1200.

194. O. PSYLLOCARPA, Leight.; thallus maculâ pallidâ indeterminatâ indicatus; lirellæ confertæ, parvæ, valde prominentes et tumidæ, oblongæ vel lineari-oblongæ, simplices, apicibus valde obtusis, rectæ vel flexuosæ, nigræ, subnitidiusculæ, longitudinaliter gracillime multistriatæ; epithecio rimiformi, clauso; hypothecium nigrum, integrum; sporæ 8, fuscæ, oblongæ, medio subconstricto, 5–6–7-septatæ, loculis irregulariter semel vel bis longitudinaliter divisis. (No. 306.)

Ad corticem, Santarem.

TAB. LVI. fig. 20, sporæ auctæ.

PLATYGRAPHA, Nyl.

195. PL. ROTULA (Mont.), forma thallo albo-punctato; sporæ 8, incolores, oblongo-fusiformes, 3-septatæ. (Nos. 481, 592, 570, 501, 577, 567, 428, 542, 593, 596, 520, 526.)

São Gabriel; Rio Negro; Panuré; Barra do Rio Negro.

196. PL. ROTULA (Mont.), forma thallo albo-punctato; sporæ incolores, fusiformes, 7-septatæ. (Nos. 456, 495.)

Barra do Rio Negro; São Gabriel.

197. PL. ROTULA (Mont.), forma thallo albo-punctato; apothecia statu juniore, clausa, verrucarioidea; sporæ incolores, oblongo-fusiformes, curvatæ, 3–5-septatæ. (Nos. 603, 475, 500, 540, 619, 531, 511, 434, 466, 426, 460.)

São Gabriel; Barra do Rio Negro; Uanauaca; Igarapé dos Ramos; Panuré.

198. PL. ROTULA (Mont.), forma thallo subdenudato punctorum alborum. (Nos. 420, 449, 432, 447, 429, 586, 579, 569, 504, 607, 439, 442, 636, 548, 497.)

Santarem; Barra do Rio Negro; São Gabriel; Panuré; Uanauaca; Marabitanas.

199. Pl. rotula (Mont.), forma *centrifuga*; thallus lineis albis prominentibus interruptis radiantibus centrifugis; sporæ oblongo-fusiformes, 3-septatæ, incolores. (Nos. 591, 423, 493, 581.)

Marabitanas; Rio Caipurú; São Gabriel; Panuré.

200. Pl. coccinea, Leight.; thallus epiphyllus, pallide virescens, tenuis, membranaceus, e cellulis radiantibus centrifugis compositus; apothecia discoidea, aperta, adpressa, rotundata aut difformia, disco plano coccineo, margine tenui, elevato, pallide coccineo, ceraceo, integro aut flexuoso; sporæ 4, incolores, anguste lineari-oblongæ, 3-septatæ, iodo vinosè rubescentes; paraphyses confertæ, crassæ, distinctæ. (Nos. 605, 465, 473, 482, 490, 443.)

In foliis variis. Barra do Rio Negro; São Gabriel.

Tab. LVI. fig. 21, sporæ auctæ 1200.

Arthonia, Ach., Nyl.

201. A. cinnabarina, Wallr. (Nos. 346, 403 statu imperfecto.)

San Carlos.

202. A. cinnabarina, Wallr., forma *detritum*, T. & B. (No. 347.)

Santarem.

203. A. melanophthalma, Duf. (Nos. 348, 408.)

São Gabriel; in ramis emortuis ad confluentiam fl. Guainia et Casiquiari.

Glyphis, Ach.

204. Gl. labyrinthica, Ach. (No. 405.)

Tarapoto.

Verrucaria, Pers., Nyl.

205. V. pyrenuloides, Mont.? (No. 260.)

Rio Negro.

206. V. variolosa, Pers. (Nos. 367, 370.)

Santarem; Obidos.

207. V. thelena, Ach. (non Mont.). (Nos. 359, 350, 360, 352, 361, 351, 358.)

San Carlos; Panuré; São Gabriel; Rio Janauari.

208. V. cinerella, Flot. (Nos. 354, 356.)

San Carlos.

209. V. HETEROCHROA, Mont. (No. 259.)
Santarem.

210. V. MARGINATA, Hook. (No. 362.)
São Gabriel.

211. V. TROPICA, Ach. (Nos. 375, 378.)
Catanacunámi; Obidos.

212. V. SANTENSIS, Tuck. (Nos. 365, 373, 372, 371, 363.)
Rio Negro; São Gabriel; San Carlos; Panuré.

213. V. CATERVARIA, Fée? (No. 379.)
Uanauaca.

214. V. PAPULOSA, Nyl. (Nos. 248, 247, 244.)
São Gabriel; San Carlos.

215. V. PORINOIDES, Mont. (No. 238.)
Rio Negro.

216. V. MASTOIDEA, Fée (Suppl. t. 41. f. 3 & 4). (No. 246, 382.)
Panuré; Casiquiari.

217. V. AMERICANA, Fée (Suppl. t. 41. f. 2). (No. 240.)
Panuré.

218. V. INNATA, Nyl. (No. 381.)
São Gabriel.

219. V. DESQUAMESCENS (Fée). (No. 380.)
Uanauaca.

220. V. PAPILLIGERA, Leight.; thallus pallide flavescens, lævigatus, opacus, margine aquosè brunneo limitatus; apothecia atra, mediocria, in cortice innata saltem in statu juniore, postea denudata, prominentia; perithecio integro, nigro; sporæ 8, fuscæ, rotundatæ vel oblongæ, apice utroque papillatæ, interne 2–5-nucleolatæ. (No. 377.)

San Carlos.

Sporis valde distincta, non ullâ specie confundenda. Paraphyses graciles, longæ, flexuosæ, distinctæ, iodo lutescentes.

TAB. LVI. fig. 22, ascus et sporæ aucta 1200.

221. V. OCELLATA, Leight.; thallus olivaceus, subnitidiusculus, cartilagineus, effusus, obscurè limitatus; apothecia obtecta, extus indicata parvis albis vel albidis rotundatis vel oblongis ocellis, planis, vix prominiusculis, centro nigro-maculatis, perforatis; perithecio integro, nigro vel fusco-nigricante, hypophlœodeo; sporæ 8, incolores, oblongæ vel ellipsoideæ, parvæ, 4-loculares, loculis interdum semel longitudinaliter divisis, iodo lutescentes; paraphyses graciles, ramosæ. (No. 244.)

Ad corticem arborum, São Gabriel.

Cel. Dr. Wm. Nylander, in litt. scripsit, "Voisine du *V. pupula* (Ach. Syn. p. 123), Cfr. Lindig. Exs. 51."

Certè facie externâ ad *V. Pupulam* (Lindig. Exs. 51!) accedens, tamen sporis atque structurâ abundè diversa.

TAB. LVI. fig. 23, spora aucta 1200. Fig. 24, sporæ *V. Pupulæ*, Ach., Lindig. Exs. 51, auctæ 1200.

222. V. SUBVIRESCENS, Leight.; thallus albido-subvirescens, lævigatus, effusus, tenuis; apothecia atra, parva, conferta, in cortice innata statu juniore, postea denudata, prominentia; perithecio integro, nigro; sporæ 8, incolores, elongato-ellipsoideæ, 3-septatæ (raro vel 1–2-septatæ), iodo lutescentes. (Nos. 357, 206, 358.)

Ad corticem arborum, São Gabriel; Santarem.

Paraphyses confertæ, distinctæ.

TAB. LVI. fig. 25, sporæ auctæ 1200.

THELENELLA, Nyl.

223. T. MODESTA, Nyl.? (No. 399.)

São Gabriel.

STRIGULA, Fr.

224. STR. COMPLANATA (Fée), Mont. = Fée, Essai, t. 2. f. 7. (Nos. 608, 614, 622, 437, 523, 565, 587, 576, 512, 484, 441, 440, 458, 613.)

Barra do Rio Negro; São Gabriel; Panuré.

225. STR. COMPLANATA (Fée), Mont. = Fée, Essai, t. 2. f. 1. (Nos. 535, 422, 575.)

Panuré; Rio Caipuru; São Gabriel.

226. STR. COMPLANATA (Fée), Mont., *anamorphosis*. (See Mont. Cuba, p. 135.)

227. STR. NEMATHORA (Fée), Mont. = Fée, Essai, t. 2. f. 4. (Nos. 640, 612, 638, 627. 451, 564, 561, 573, 418, 560.)

Marabitanas; Barra do Rio Negro; São Gabriel; Casiquiari.

228. STR. ACTINOPLACA, Nyl. (Nos. 496, 509, 452, 503, 588, 602, 517, 508, 455.)

Forest near Pará; Barra do Rio Negro; São Gabriel; Panuré.

229. Str. nitidula, Mont. (Nos. 532, 621, 525, 521, 621, 396.)

Tarapoto; Rio Negro; Panuré.

Trypethelium, Ach.

230. Tr. uberrimum, Fée. (No. 253.)

San Carlos.

231. Tr. pallescens, Fée. (Nos. 393, 394.)

San Carlos.

232. Tr. Leprieurii, Mont. (No. 261.)

Rio Negro.

233. Tr. annulare, Mont. (No. 257.)

Barra do Rio Negro.

234. Tr. madreporiforme, Eschw. (No. 255.)

Santarem.

235. Tr. quasslæcola, Fée. (Nos. 256, 390.)

Santarem.

236. Tr. Feei, Fée. (Nos. 391, 392, 368, 349, 376, 369.)

San Carlos; Igarapé dos Ramos; Santarem; Rio Negro.

237. Tr. Sprengelii, Ach. (No. 386.)

Rio Negro.

238. Tr. platystomum, Mont. (No. 266.)

Santarem.

239. Tr. purpurinum, Nyl. (in Mus. Petropol. 1862); thallus flavido-olivaceus, cartilagineus, crassus, verrucoso-rugosus, demum pulvere coccineo suffusus; apothecia in prominentiis stromaticis crebris confertis confluentibus immersa (singulum vel plura in quâvis); ostiolo aperto, margine annulari crasso stromatis cincto; epithecium planum, centro perforatum, depressum, coccineum, intus fusco-nigrum; sporæ 8, incolores, maximæ, cylindrico-fusiformes, multiloculares, loculis muraliter divisis, iodo lutescentes; paraphyses confertæ, intricato-ramosæ.

Ad corticem *Murixi*, Santarem.

Tab. LVI. fig. 6, spora aucta 1200.

240. Tr. scorioides, Leight.; thallus maculâ flavidâ indicatus; apothecia in verrucis stromaticis irregularibus nigro-fuscis difformibus confluentibus, intus nigro-fuscis;

sporæ 8, incolores, mediocres, elongato-oblongæ, 8-anguloso-quadriloculares, iodo leviter cærulescentes; paraphyses graciles, distinctæ. (No. 263.)

Ad corticem arborum, San Carlos.

Tab. LVI. fig. 26, spora aucta 1200.

Astrothelium, Eschw.

241. A. conicum, Eschw. (Nos. 258, 252, 262, 409.)

Santarem; Maypures; in ramulis emortuis ad confluentiam fl. Guainia et Casiquiari.

242. A. sulphureum (Eschw.). (No. 243.)

Obidos.

243. A. septicollare (Eschw.). (No. 237.)

San Carlos.

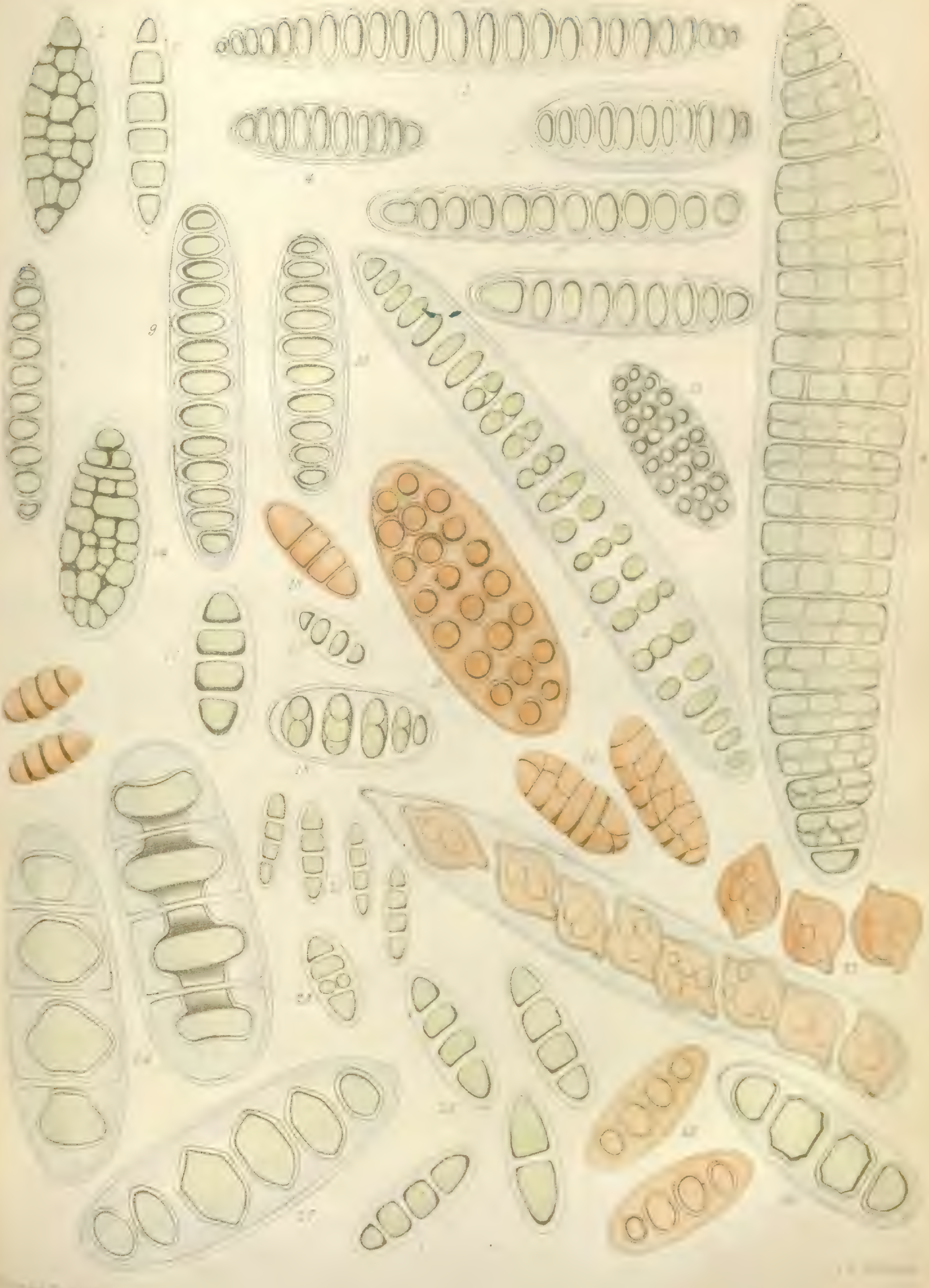
Identicum specimine recepto a rev. Prof. Churchill Babington ita nominato. "21 Lich. Amaz., Spruce; '*Pyrenastrum septicollare*, Eschw.,' Montg. No central perithecium, and therefore not *P. album*, Eschw., according to Montagne. Carissi, Pará."

Sporæ 8, fuscescentes, ellipsoideæ, mediocres, 4-loculares, iodo non tinctæ, paraphyses distinctæ. (Plate LVI. fig. 28.)

244. A. subclandestinum, Leight.; thallus maculâ effusâ pallidè olivaceâ indicatus; apothecia in verrucis subhemisphæricis subdepressis inclusa, intus fusco-nigris; peritheciis 2–6, nigris; ostiolo parum conspicuo; sporæ 6, incolores, elongato-oblongæ, anguloso-6-loculares, iodo non tinctæ; paraphyses confertæ, indistinctæ. (No. 242.)

São Gabriel.

Tab. LVI. fig. 27, spora aucta 1200.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XVIII. *On* Myostoma, *a new genus of the* Burmanniaceæ.

By John Miers, *Esq., F.R.S. & L.S., Commend. Ord. Imp. Bras. Rosæ.*

(Plate LVII.)

Read June 7th, 1866.

In April 1847, I communicated to the Linnean Society the account of a new Brazilian genus of the *Burmanniaceæ*, which was published in the Twentieth Volume of the Society's Transactions, under the name of *Ophiomeris*. I showed that in its more essential characters it accorded with the Indian genus *Thismia*; and in order to include these two genera in the family, I proposed to form a third tribe, *Thismieæ*, distinguished from *Burmannieæ* and *Dictyostegieæ* by having an apterous perianth with a 6-lobed border (each alternate lobe being contracted into a long subulate spur), and a succulent capsule which opens by a circumscissile line. I have now to describe a third genus of the *Thismieæ*, which is also of Brazilian origin, its chief peculiarity consisting in the shape and condition of the three inner segments of the border of the perianth, which do not open in the usual manner, but remain constantly closed, for which reason the name of *Myostoma* is given to it*.

In the regular form of the perianth it resembles *Thismia*: the tube is not gibbous; and its contracted mouth is in the vertex, not excentrically placed on one side as in *Ophiomeris*. The perianth is succulent, infundibuliform, regularly ventricose towards the summit, where it is suddenly contracted into a short cylindrical mouth, which is terminated by three short erect teeth; these teeth, or rather claws, belonging to the segments, have the same breadth as their sinuated intervals, and they suddenly become expanded into three orbicular very convex segments three times the breadth of the claws, each being cordately expanded below into two rounded connivent auricular lobes which embrace the claws; these segments, arching over the centre, remain imbricately closed, and thus entirely conceal the mouth. The other three alternate segments are fleshy, extremely narrow, with their margins revolutely coiled back, so that they assume a subulate form; they are external, as in *Thismia*, not spirally coiled within the tube in æstivation as in *Ophiomeris*; they arise immediately below the contracted portion of the tubular mouth, beneath each sinus, thus alternating on a lower level with the auriculately lobed segments; they are nearly the length of the tube of the perianth, at first spreading horizontally, then curving downwards. The six equal stamens are quite free from each other, and not united into a broad free annular ring as in *Thismia* and *Ophiomeris*; the filaments, opposite the segments, and pendently attached immediately below the contracted mouth of the perianth, are short, somewhat filamentous, and widely separated; each connective is a cuneiform plate, about the length of the filament, with two long sides narrowing into an obtuse point, and truncated at the opposite end, the angles of which are prolonged into two erect horn-like appendages of equal length; and from a point between these it is attached to and suspended from the end of the filament. These stamens at first converge towards the axis, over the stigma, but ultimately they collapse into a pendent position, the anthers being fixed extrorsely, and turned towards the face of the perianth. The anther consists of two distinct, oblong, parallel or slightly converging lobes, each bilocellate, dorsally adnate to the connective, and opening bivalvately by a median longitudinal suture, the margins of which detach themselves from the septum. In the flowers examined, the anther-cells had discharged their pollen; but some few of the granules still remained in the cells, while others were distributed over the surface of the perianth. These pollen-grains are somewhat large (0·003 in. in diam.), globular, extremely transparent, and of a very pale hue, with a minutely reticulated surface, and three slight hyaline protuberances on the margin; but these protuberances are not lengthened into boyaux as in *Dictyostega*; the pollen is therefore quite of the ordinary structure.

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* From μύω, *occludo*, and στόμα, *os*.

The ovarium is wholly inferior, turbinate in form, 1-celled, with three parietal placentæ, as in *Ophiomeris*; it is crowned by a convex fleshy epigynous disk, from the centre of which the somewhat short cylindrical style rises, bearing the stigma, which is equal to it in length, suddenly incrassated, and cleft almost to its base into three nearly erect lobes with minutely papillose surfaces, their summit scarcely reaching the middle of the tube.

The fleshy hyaline capsule grows to a size four times that of the ovary, and in consequence of the fall of the perianth at the period of maturity, by a circumscissile line of separation along the margin of the epigynous disk, it remains like an open-mouthed truncated turbinate cup; it has three short parietal placentæ, which do not meet in the base, and rise to the height of one-fourth of the length of the cup; they are as broad as the intervening spaces, and are densely covered with very numerous minute seeds upon long funicles, all forming a crowded mass in the bottom of the cell.

These minute seeds, though similar in form, are somewhat larger than those of *Ophiomeris*, being 0·05 in. long and 0·02 in. broad; they are suspended by a rather long funicle: the outer tunic is very lax and transparent, as in *Burmannia*, with about twelve longitudinal carinated ribs, which are parallel and uninterrupted, arcuately conjoined at the apex, where they terminate in a wide, open, truncated mouth; below they are connected with the somewhat narrower hemispherical reticulated and translucent base of the integument: the spaces between the longitudinal ribs consist each of a single narrow areole, filled with a pellicular membrane which, under a powerful microscope, is seen marked by numerous closely parallel, very diagonal lines, slanting obliquely downwards from left to right; and the ribs themselves are fissile down their middle through their entire length. The funicle by which the seed is suspended is 0·04 in. long, with a diameter of 0·0055 in.; it is transparently hyaline, forming an extremely thin pellicular hollow cylinder, marked by six or eight very delicate lines, which extend in an uninterruptedly parallel direction from one extremity to the other, the interspaces being streaked by close transverse lines so extremely minute that they can be discerned only under a very powerful microscope: thus magnified, these interspaces assume the appearance of muriform tissue. The extremity of the funicle, where it is attached to the seed, is not decurrent along the outer surface of the integument, as usually occurs, but enters its broad open mouth, within which it is attached on one side, and where its further progress is lost; and it should be especially noticed that there is no indication of the presence of a raphe, or of spiral vessels, or ducts of any kind, either in the integument or in the funicle. Besides the lines above described, we see within the pellicular tube of the funicle, when viewed under a high power, as well as beneath the cuticle of all parts of the plant, more especially on the inner surface of the perianth, a number of rounded yellow glands, irregularly scattered, which might be mistaken for pollen-grains; but they are very different, less than half their size, yellow and granulated, and apparently fixed upon the cuticle.

In analyzing the seed, the readiest method of separating the outer seminal integument from the body which it encloses is to place one of them on a sheet of paper, covering it with a glass slide; then moving the latter by a gyratory motion under moderate pressure, the outer integument will be seen to split, not along the delicate pellicular interspaces, but through the middle of its more solid carinated nervures; and it thus opens valvately from the mouth downwards into segments united at their base, after the manner of dehiscence of an ordinary capsule. The oval body thus liberated from the pulvinate base of the outer integument, is about two-thirds of the length of that tunic; it seems to contain a torulose yellowish nucleus, apparently formed of three or four series of aggregated nodules, just as was formerly described in the seed of *Ophiomeris*, and figured in the Linnean Transactions, vol. xx. pl. 15. figs. 18 & 19.

When the integument of the oval body thus liberated is ruptured by the point of a needle, under water, about eighteen loose spherules become disengaged, which are irregular in size, somewhat angular in shape, of a dark-brown or blackish colour when fully matured, more or less opake, and appear to consist of numerous very minute oily cells, aggregated together somewhat loosely around a larger central globule, seemingly transparent and of an oily nature. When these spherules are placed under a compressor, the central oily globule escapes, the more minute cells are separated, and with them a number of black extremely diminutive atoms, which look like the sporidia of Acrogens. It should be mentioned that the spherules first mentioned show no vestige of any reticular covering; so that they cannot be compared with the spore-cases of Ferns; and after the most careful search nothing like an embryo could be perceived. The seeds examined had never become dry, having been preserved in spirits from the time the specimens were collected to the period of their examination, when they were placed in distilled water, lest any extraneous earthy particles might interfere with the results. The investing integument, when cleared of its contents, is found to be a simply reticulated membrane, cancellated, with rather large areoles, and has no appearance of any chalaza, raphe, or vessels of any kind. Such are the only results I have been able to obtain after numerous attempts, carefully repeated, to analyze the seed of *Myostoma*.

I have omitted, in the previous details, one circumstance which appears to me worthy of notice. Although, as before stated, no tracheal or other vessels usually found in seeds can be seen in the funicle, or in either of the integuments of the seed of *Myostoma*, they are distinctly observable in other parts of the plant: the stem, composed entirely of transparent hexagonal cells, has a medullary cord running up its centre, formed of a bundle of spiral vessels, which on reaching the base of the ovary, divides itself into six portions, severally following the course of its sulcated furrows, three of them thus passing by in close proximity to the placentæ, but without communicating with them; and all are continued along the grooves of the tubular perianth, thus touching the stamens, and they extend to the extremities of the six segments of the border: no spiral vessels are found in any other parts of the plant. Prof. Henfrey (Linn. Trans. xxi. tab. 2) shows the funicle and integument of the ovule of *Orchis* as being quite cellular and destitute of vessels; but I have found spiral threads abundantly in the longitudinal placentæ of many Orchidaceous plants; I could find no trace of them in the placentæ of *Myostoma*. The tissues of most of the Rhizogens are said to be deficient of tracheal vessels; but they have been detected in some of the *Balanophoreæ*.

The resemblance of the apparently torulose body contained within the seed of *Myostoma* to the nucleus delineated by Mr. Robert Brown in the seed of *Rafflesia*, in the Linnean Transactions (vol. xix. plate 25, R. B.), is too remarkable to pass over without notice. Bauer, who repeated Mr. Brown's analysis, and prepared the drawings for that memorable memoir, figures the nucleus as he saw it under the most powerful microscope, considering it to be a simple cylindrical embryo of homogeneous texture; but under the more penetrating observation of Mr. Brown, it was resolved otherwise and as he drew it separately in the figure marked R. B. in the same plate: according to his view (*l. c.* p. 228), this "embryo consists of large cells disposed nearly, but not with absolute regularity, in two longitudinal series, and so transparent that it may be safely affirmed that there is no included body, nor any perceptible difference in the contents of any of the component cells." It was in this manner that I regarded and described, nineteen years ago, the nucleus or supposed embryo of *Ophiomeris* (Linn. Trans. xx. 376, pl. 15. figs. 18, 19).

Griffiths defined the seed of *Thismia* (Linn. Trans. xix. 342) as consisting of two integuments, the outer one being "celluloso-areolate, fragile and easily separable, the inner one extremely slender, membranaceous, scarcely separable, and containing a cellulose waxy mass (embryo) composed of cells filled with grumous molecules and oily matter," but he gave no figure to explain any further meaning.

Dr. Lindley, founding his views principally upon the evidence of Brown in regard to *Rafflesia* and *Hydnora*, and the details he had obtained from Griffiths concerning the *Balanophoreæ*, separated these and all analogous plants from Exogens, on account of their "homogeneous or anembryous sporuliferous seeds;" and in his 'Elements of Botany,' p. 226, he defines the Rhizogens, or *Rhizanths*, as "wholly or nearly destitute of vascular tissue; and when their seed is fertilized, instead of an embryo being formed, the issue is a mass of sporules or reproductive bodies analogous to those which *Acrogens* have instead of seeds."

This definition was considered by Mr. Griffiths (*l. c.* p. 306), "to be open to the gravest objections." He did not oppose the use of the term "homogeneous," which he considered correct, but the case was very different when that term was connected with the want of an embryo and with a sporuliferous mass: he did not find the appearances presented by the seeds to be uniform; and the only cases that support "the hypothesis of their being composed of a sporuliferous mass are *Mystropetalum* and *Sarcophyte*" (p. 307). This opinion, as we shall presently see, is opposed to the views of Dr. Hooker, who considers that among the *Balanophoreæ* "the only known embryonate and albuminous genera are *Cynomorium, Sarcophyte,* and *Mystropetalum*" (Linn. Trans. xxii. 18). Mr. Griffiths regarded all the other genera of that family, including *Thismia*, as having seeds enclosing "a densely cellular homogeneous body, each cell containing granules and globules of an apparently oleaginous fluid, the appearance being that of some forms of albumen" (*l. c.* p. 307). He was convinced that these bodies were the embryos described by Mr. Brown as being homogeneous and acotyledonous, and which exist in a marked degree in *Thismia*, also in *Orchidaceæ* and many plants parasitic on roots.

Dr. Hooker, in his excellent memoir on *Balanophoreæ* (Linn. Trans. xxii. 17), attributed to the seeds of many genera of that family a similar structure, and his observations serve to throw much additional light upon this interesting inquiry. The ovule of *Balanophora involucrata*, as shown in Pl. V. figs. 11 and 12, at an early stage of its growth "consists of a delicate hyaline sac, suspended almost immediately below the insertion of the style, and containing two free spherical cells, each full of fluid and covered with opake spots, which are probably cytoblasts. The formation of cells proceeds with great rapidity within the sac;" but he was unable to trace their further evolution. If it could be proved, as Dr. Hooker was inclined to believe, that these cells are analogous to the ordinary embryo-sac of phanerogamous plants, it would be a very important fact; but we must yet regard this as a mere supposition; for although he perceived within the style a filament, like a pollen-tube (as shown in figs. 16 and 17), he could not trace it into the cavity of the ovary, there was no indication of its having been fertilized, nor was he able to observe any vestige of chalaza, raphe, or foramen by which impregnation could be effected: the ovule gradually swells till it is matured, and then consists of a dense opake mass of cohering hexagonal cells.

In regard to the nature of the seed in *Balanophoreæ*, Dr. Hooker infers (*l. c.* p. 18), as Griffiths in a somewhat different manner had conjectured before him, that there are two types of seminal structure in that family:—1st. The embryonate, found only in *Cynomorium, Sarcophyte,* and *Mystropetalum*; 2nd, the exembryonate, which includes all the other genera, whose seeds consist of a homogeneous or sporuliferous mass as above described. But if we regard the facts established by these botanists, the conclusion seems irresistible that the three genera whose seeds have a distinct nucleus (perhaps miscalled an embryo), imbedded in a fleshy, more or less solid, albumen, should be considered ordinarily distinct from all the others, which have no albumen and no embryo; for under such contrary conditions, if we regard consistency, they ought not to be retained in the same natural family. By the separation of the former as the *Cynomoriaceæ*, consisting of the three tribes already established, the *Cynomorieæ, Mystropetaleæ,* and *Sarcophyteæ*, we have the *Balanophoraceæ* remaining, whose genera are all uniformly marked by similar essential characters. Holding in view therefore the extreme difference in the organization of its seeds, the *Cynomoriaceæ* would stand further separated from *Balanophoraceæ* than *Triuridaceæ* or even *Burmanniaceæ*. The chief reasons which induced Dr. Hooker to include *Mystropetalum* in *Balanophoraceæ* were its habit, its valvate tripartite perianth, its stamens placed opposite the lobes of its border, and its extrorse anthers, in all which characters that genus equally resembles *Triuris* and *Soridium*: these, however, differ in their diœcious flowers and numerous ovaries. Were the *Cynomoriaceæ* separated from *Balanophoraceæ*, as above indicated, they need not on that account be excluded from the Rhizogens, or merely because of the presence of albumen in their seeds, especially as our present knowledge seems to show that the organ which has been called their embryo consists of an aggregation of sporule-like granules similar to those which we find in all the other orders of this class of plants.

In order to know the limits of the Rhizogens as a peculiar class, it is desirable to investigate the circumstances which give rise to the reproductive power of their seeds (in which no trace of a cotyledonary embryo can be detected), and to inquire into the manner of the fertilization of their ovules. In the ordinary embryo, as is well known, its radicle, under conditions favourable to its development, extends into a root, while the rising stem and its first leaves are produced by the expansion of the plumule and cotyledons; in that exceptional condition of the embryo, such as in *Cuscuta*, *Orobanche*, *Arum*, &c., where the cotyledons, plumule, and radicle are fused into a fleshy mass, there is always some pullulating point on its surface out of which the young stem and its root are expanded. But no development of such a nature has been found in any of the Rhizogens: indeed all our knowledge on the subject of their reproduction is purely negative; that is to say, although nothing absolutely certain is yet ascertained on this point, we assuredly know that the mode of the germination of its seeds is different from that of all other classes, and that in this particular alone the Rhizogens stand quite isolated. On this topic many hypotheses have been suggested, none more probable than that of Mr. Brown, who suggested (Linn. Trans. xix. 232) the possibility that, in all these plants, their propagation is effected by the generation of cellular tissue proceeding from the sporuliferous contents which compose their peculiar kind of "homogeneous embryo," the growing molecules of which penetrating and extending under the bark of the parent stock, by their progressive development, produce new and fully matured parasites, a development in its ultimate results as effective as the growth resulting from the cotyledonous embryo, which in Exogenous and Endogenous plants is considered essential to their reproduction. We have, however, as already stated, no positive evidence by which this ingenious hypothesis can be supported.

In regard to the fertilization of the ovule, although we are not aware of the manner in which this takes place, we are quite certain that an impregnation of some kind must be effected in Rhizogens. In the *Burmanniaceæ* we find all the usual sexual parts as perfectly developed as in the higher orders of Endogens and Exogens—that is to say, a perfect perianth, stamens completely formed, anthers charged with grains of pollen possessed of the same mode of expansion and apparent function; for, in some cases, we see the pollen-tubes issuing from each anther-cell and brought into contact with a 3-lobed stigma provided with papillose surfaces; from this point we trace the usual stigmatic channels through the style, and sometimes (but not always) thence through other passages, which convey the fecundating influence to three parietal placentæ in the ovary, all charged with numerous ovules; these are suspended by their funicles, and grow into seeds, each provided with the ordinary number of integuments. It therefore seems extraordinary that, with all these appliances just as we see them in the most perfect Phanerogamia, after the fertilization of the ovules and the growth of the seeds, no indication can be detected of the presence of a cotyledonous embryo, which invariably is generated by the same sexual apparatus in all Exogens and Endogens.

Many of the most celebrated physiological botanists have maintained (and their views have obtained general assent) that in fecundation it is a necessary part of the function that the pollen-grains, on touching the stigma, should emit those capillary prolongations known by the name of boyaux, or pollen-tubes, which then descend along the style by forcing their way through its external channels, which in ordinary cases are connected through other similar passages within the ovary, communicating with the placentæ; it is further maintained that, in order to fertilize an ovule, it is essential that one or more of these pollen-tubes should travel thus far, so as to enable it to reach the foramen of the ovule which it enters, thus coming into contact with the embryo-sac, when, by the stimulus exerted by this mere juxtaposition, it gives rise to the formation of a germinal vesicle within the sac, which grows into an embryo, the sac affording nutritive power to the embryo by its connexion with the chalaza.

This ingenious theory of the agency of the pollen-tube, so willingly and so generally accepted, is, however, doubted by some botanists, who have brought many strong arguments to prove its fallacy. Among these, one of the most disconcerting is the improbability that a pollen-grain should possess the potency of suddenly emitting a tube the length of 20,000 times its own diameter (for it would sometimes require to be 6 inches long), and drive forward this delicate thread against the powerful resistance which mere friction would impede to its progress through a channel of such length and equally extreme tenuity; it becomes, indeed, an argument of great weight that the power necessary to effect this would be too enormous to be supported in a fabric of such delicate texture —a power which no one has seen, and which no reflecting mind can believe to exist. It is, moreover, argued that where such pollen-tubes have been seen, or rather are supposed to have been seen, at the termination of the stigmatic channels, the eye has been deceived by appearances arising from another well-ascertained structural development of a very different nature, which may easily be mistaken for pollen-tubes.

There appears much reason in these arguments, and not less so in others that have been advanced; and if they hold their ground, we must fall back again upon the now antiquated but by no means irrational view, that it is not the pollen-tube, but simply the fluid material contained in the pollen-grain, and emitted from its tubes, which is the direct agent in the process of fertilization. No one can doubt that such a fluid could readily be conveyed through the extremely narrow channels of the style by the well-known law of capillary attraction; by such means, directly or indirectly, the fluid would quickly reach the micropylar extremity of the ovule, when, entering the foramen, the fertilization would be effected by its impact upon the embryo-sac—a mode of stimulation similar to, and as feasible as, that of the impregnation of the ovum, known to be universal throughout the animal kingdom. It is only a revival of a doctrine long entertained, to compare the active fovillæ of the pollen-grain with the spermatozoa of animals, and to indicate the correspondence of their main function *.

I will not attempt to deny categorically the truth of the doctrine now universally entertained, that it is the pollen-tube alone, simply by its impact on the embryo-sac, which effects the fertilization of the ovule; for it must be confessed that this theory, if founded upon fact, is one which seems to fulfil all the conditions necessary to account for the phenomena of impregnation. The fact itself, if universal in its operation, is one that ought to be patent to every observer; but I can safely affirm that in the numberless instances in which I have searched for the presence of a pollen-tube in the foramen of the ovule, I have never yet been able to discover one. This is an objection of no weight whatever, as it might well arise from my obtuseness of vision, or a want of sufficient dexterity. As, however, I shall be able to show that such a mode of impregnation does not occur in *Myostoma*, and as the belief in the doctrine referred to as applicable to all phanerogamous plants is now so universal, I thought it desirable to sift the evidence we have on record, and which I now adduce, upon which this general belief is founded. It appears to me that this review will induce most persons, who have not prejudged the question, to come to the conclusion that the very important fact alluded to has not yet been satisfactorily proved.

The proofs of the facts under consideration are generally supposed to be furnished by Mr. Brown's celebrated memoir "On the Organs and Mode of Fecundation in *Orchideæ* and *Asclepiadeæ*," published in the 16th volume of the Linnean Society's Transactions. I have examined that memoir with great care, but can nowhere perceive any fact advanced to support the belief above mentioned as regards the agency of the pollen-tube; on the contrary, I will show, by quoting Mr. Brown's own words, that his important evidence does not point to that conclusion.

Mr. Brown, with his usual caution and profound sagacity, remarks that Amici first announced the discovery of the penetration of the pollen-tubes into the cavity of the ovarium in several plants, and believed (though he never saw it) that in every case of fertilization a pollen-tube comes into contact with the ovule; and Dupetit Thouars fancied he saw in *Orchideæ* ramifications from pollen-cords mixing with the ovules; but Mr. Brown states positively that his own observations had not advanced so far on that important point, and "that what he had to adduce concerning *Asclepiadeæ* made him hesitate still more from adopting these statements" (*l. c.* p. 707). It will be seen that his own details support this disbelief. He observed in *Bonatea*, and in general among the *Orchideæ* (p. 727), prior to the evolution of the pollen-tubes, a series of

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* The surprising vital energy of the fovillæ, and the rapidity of the motion of these particles, which vary considerably in size (from $\frac{1}{4000}$ to $\frac{1}{30000}$ of an inch), though first seen by Gleichen a century ago, was scarcely noticed until Brown called attention to the fact, which he fully described (R. Brown, Misc. Bot. Works, i. 466). The circumstance again fell into oblivion after the general belief in the theory of the agency of the pollen-tube in impregnation; but lately M. Faivre has once more called attention to the subject (Bull. Soc. Bot. France, vii. 772), and has described the "mouvement Brownien" in the pollen of *Gloxinia*, which, he says, is of long duration, the fovillæ having not only a rotary motion round their axis, but a lateral sliding, and an advance of one particle beyond another; and he also observed that a conjunction of these granules sometimes takes place: this last circumstance was also noticed by Brown in the pollen of *Lolium perenne* (*l. c.* p. 463).

"mucous-tubes," first apparent on the stigma, which gradually extended themselves through the style in a bundle like a cord, which, on reaching the summit of the ovary, there became divided into three lines running parietally along the sides of the cell; and on reaching the beginning of the three placentæ, each line again divides into two branches, which run along the sides of the placenta (p. 706); and he noticed the extremities of many of these "mucous-tubes" scattered over the surface of the placenta (p. 742). At first he took these "mucous-tubes" to be pollen-tubes, (p. 739), but he afterwards retracted that opinion. He states that, in size, in number, and in appearance, they so greatly resemble them, "that they are with difficulty distinguishable" from them (p. 741). Having traced these "mucous-tubes" to the sides of the placentæ, he remarked that those which were scattered over their surface became remarkably and irregularly flexuose (p. 743); and in not a few cases he traced them into the mouths of the ovules, to which they adhered with considerable firmness [p. 742]. The fact "that the tubes thus traced to the foramen of the ovules are of the same nature as the mucous-tubes, and not those produced directly by the pollen, was proved [to him] by their exact agreement with the former in every respect" (p. 743), except by not being granular on their surface and distinguished by having generally those interruptions in the cavity, formed of a substance which he termed "coagula," and which he never met with in the tubes actually adhering to the grains of pollen (p. 741). In his concluding remarks, he states that the two most important facts, which he considered to be the résumé of his researches, are, 1, "the production of tubes not directly emitted from the grains of pollen, but apparently generated by them" (or, to have spoken more correctly, which become visible at the period of the emission of the pollen-tubes and their application to the stigma, as shown in p. 739), and, 2, "the introduction of one, or sometimes more than one of these [mucous] tubes into the foramen of the ovule" (p. 743).

We may deduce from these facts, that the "mucous-tubes," here so minutely described, and to the agency of which so much importance is attached, are the stigmatic channels accurately described by Mirbel under the name of "vaisseaux conducteurs de l'aura seminalis"*, as contradistinguished by him from the "vaisseaux nourriciers" of the placenta (which extend to the funicle of the ovules), and that the extremities of the "mucous-tubes" which spread over the placenta, and where they become much curved, constitute that peculiar fringe-like tuft called "telæ conductrices," some of which tubes were seen by Mr. Brown to enter the foramen of the ovules, and there become agglutinated to them (*l. c.* p. 742)—a circumstance that should be especially remembered. The function of this fringe of tissue is to conduct the fertilizing influence transmitted from the stigma through the "mucous-tubes" to the apex of the ovules,—this adaptation being clearly portrayed in the great number of cases figured by Prof. Agardh in his 'Theoria Systematis,' where the mouths of the ovules, in the course of their development, become nestled in this fringe-like tuft. In fine, there is not a single fact described by Mr. Brown in his celebrated memoir to prove, nor an opinion stated to show, that the pollen-tube ever reaches an ovule in the *Orchidaceæ*.

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* Mém. de l'Acad. vol. ix. p. 633.

M. Brongniart states confidently [*] that he never was able to see the pollen-tubes descending the style as Amici had asserted; he searched for them with great care, but was unable to trace them beyond the tissues of the stigma, where they terminated.

Subsequently, in one of his latest communications to the Linnean Society, Mr. Brown further stated, in regard to the "supposed pollen-tubes," or what he termed "mucous-tubes" (equivalent to the stigmatic channels of Mirbel), which he observed in *Cytinus*, running along the style, and reaching the cavity of the ovary, their extremities there mingling with the ovules, that he never found any of them applied to the apices of the ovules, even after their enlargement [†].

Mr. Brown's observations, as above quoted, are somewhat modified in the same memoir, in regard to the *Asclepiadeæ*. His invaluable researches prove that the pollen-mass in that family consists of a congeries of pollen-grains agglutinated together as in the *Orchideæ*: he there observed the protrusion of a single tube from each pollen-grain; but this did not take place before the pollen-mass touched the stigma, when, by its stimulus, the tubes were evolved and combined together in a loose bundle, which now passed over the surface of the large stigma; and at the moment the latter breaks away from the two styles, this bundle is seen to enter their large apertures. Consequently, the styles and ovaries being usually very short, it is not surprising to find this bundle of tubes passing through the large opening of the styles into the cell of the ovary. But though Mr. Brown saw them in this position, as shown in plate 34. fig. 11, he states positively that he was never able to trace any one of the tubes further than the commencement of the placenta (p. 726); and so rarely does this happen, that it was only in a single species of the family that he was able to see consecutively "the rupture of the pollen-mass, the production and protrusion of the pollen-tubes, their union into a cord, with the course and entrance of this cord into the cavity of the style" (p. 729). He describes the pollen-tube as being very transparent, $\frac{1}{2000}$ inch in diameter, neither branched nor jointed, and with no apparent interruptions in its cavity; and, though sometimes of a comparatively considerable length, it cannot be said to be emitted from the pollen-grain, but is manifestly an elongation of its inner membrane (p. 725).

In regard to the fertilization of the ovule in *Orchidaceæ*, Mr. Brown states (p. 709) that, "at the period when the nucleus has acquired more than half the size it attains in the ripe seed, a thread may be traced from its apex very nearly to the open end of the testa, or to the apex of the original nucleus, consisting of a simple series of short cells, in one of which he observed a circulation of very minute granular matter, the lowermost cell being the rudiment of the future embryo;" but there is no attempt here to show that there is any connexion between this thread and a pollen-tube.

Prof. Henfrey, in his memoir "On the Development of the Ovule in *Orchis*" (Linn. Trans. vol. xxi. plate 2. fig. 27), portrays the growth of the confervoid filament just mentioned, showing it in figs. 15 *et seq.*, together with the earliest contact with it of what he conceived to be a pollen-tube, but which is manifestly identical with the extremity of the "mucous-tube" so well described by Mr. Brown, agreeing with it in all essential respects: it never enters the embryo-sac, but deviates a little on one side during the elongation of the confervoid thread. In the progress of this growth, he observed (p. 8) the pistillary cords extending nearly to the base of the ovary, lying alongside the placenta, presenting the appearance of pollen-tubes, and seemingly continuous with those seen on the stigma, derived from pollen-grains. This corresponds precisely with all that Mr. Brown minutely describes, who affirms positively that they are not pollen-tubes, though greatly resembling them. Prof. Henfrey's memoir, therefore, does no more than confirm the very accurate observations of Mr. Brown, and affords no better proof of the conveyance of the pollen-tubes from the stigma to the mouths of the ovules, or of their immediate agency in the act of fecundation.

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[*] Ann. Sc. Nat. xx. 332.

[†] Linn. Trans. xix. 227.

Though the existence of pollen-tubes cannot be doubted, their utility and their true function may admit of another interpretation. It should be remembered that they are not formed of ordinary cell-structure—that is to say, of pointed consecutive cells capable of self-extension, which would admit the possibility of their progressive growth to any length desired; but, as Mr. Brown has described them, each pollen-tube is a single elongated cell produced by the mere expansion of the delicate pellicular inner tunic of the pollen-grain, and which, from the manner of its production, must be of very limited length; and though longer in some cases, in most instances they are rarely seen longer than the diameter of the pollen-grain. This extension is evidently a contrivance for some special purpose, the design being probably that it may be able to penetrate the mouths of the stigmatic channels, and serve as a funnel for pouring out and directing the course of the fluid contents of the pollen through these "mucous-tubes" to their ultimate destination.

The structure seen in the *Burmanniaceæ* seems to favour this view of the subject. I have shown, on a former occasion, that in all the genera of the tribes *Burmannieæ* and *Dictyostegieæ* the communication between the stigmata and placentæ is direct and perfect, and that the pollen-grains in *Dictyostega* emit copiously an entangled cottony mass of delicate threads, which strongly adhere to the stigma, and show the empty utricles of the pollen-grains suspended from their extremities; but there is no evidence to demonstrate that these threads, which enter the stigmatic channels, are continued beyond their orifices and carried to the placentæ. Analogy strongly points to the negative; for in *Myostoma* and *Ophiomeris* there is a want of all direct means of communication between the style and the placentæ, the stigmatic channels ceasing at the base of the style. Now, if it were essential for the fertilization of the ovules, as the prevailing doctrine insists, that the pollen-tubes should be prolonged so as to reach the ovules in the bottom of the cell of the ovary, then we ought to see them issuing from the base of the style into the cavity of the cell; and as the ovary contains upwards of a hundred ovules, the pollen-tubes in corresponding number would form a thick bundle which could not escape observation. It is therefore only necessary to say that, as no such fascicle of threads is to be seen in *Myostoma*, we have it demonstrated that, in this case, the theory of the application of pollen-tubes for the fertilization of its ovules is distinctly disproved. On the other hand, if we here adopt the view before explained, that the fluid contents of the pollen-grains alone pass through the stigmatic channels in

Myostoma, the mode of the fertilization of its ovules is more easily accounted for. This absence of stigmatic channels between the base of the style and the placentæ is far from a rare occurrence in phanerogamous plants; I pointed to it in the case of *Ephedra*, and quoted several authors who had observed the same circumstance in numerous other families[*].

Among these it may be especially noticed that Dr. Weddell, in his admirable memoir on the *Urticeæ*[†], shows that the ovary is unilocular, and the ovule is attached by its funicle to the base of the cell, and that its micropyle points upwards: here no channel of communication exists between the stigma and basal placenta, the stigmatic channels of the style terminating in the summit of the cell, where a tuft of tissue is seen similar to that described by Mr. Brown on the placentæ of *Orchideæ*, and to which the expanded mouth of the outer coating of the ovule adheres with considerable tenacity; and he adds, "il n'est même pas rare de voir le tissu conducteur pénétrer dans l'exostome [micropyle] et l'obturer complètement," precisely in accordance with the observations of Mr. Brown. There is no mention anywhere of the descent of pollen-tubes to perform the act of fertilization.

In corroboration of this, it may be mentioned that Dr. Hooker and Mr. Griffiths saw pollen-grains upon the stigma of *Balanophora*, but failed in tracing any transmission of pollen-tubes[‡]; and I quote the words of the former (*l. c.* p. 17), showing that he could obtain no clue to the period when impregnation took place; nor could he trace any indication of a chalaza, raphe, or foramen, at which "impregnation is probably effected."

The want of an embryo in the seed would lead us to infer that in the nucleus of the Rhizogens there is no embryo-sac, in the ordinary acceptation of the term, and that the development of the ovule is different in its nature from that of Exogens and Endogens. We have as yet little knowledge on this subject; but in future investigations it must be remembered that in *Myostoma* the mouth of the external tunic of the ovule is never closed, that its funicle is tubuliform, and that it terminates in the mouth of that tunic, that there is no raphe, no vestige of a micropyle in its summit, or of a chalaza in the base of the inner integument. These very exceptional points of structure, by their influence upon functional development, would alone almost lead us to expect a difference in the organization of the seed.

In this organization, as observed in *Myostoma*, and which seems to prevail generally in Rhizogens, are we to assume that an embryo is absolutely wanting, or can it be so very minute as to escape our means of observation? The latter view is not easily maintained, because in all cases where a very small embryo exists it is enveloped in a very homogeneous large mass of albumen, composed of cells of great cohesion; but here the mass of the nucleus does not appear to approach in any way to the nature of albumen, it is divided by the slightest pressure into irregular nodules, some more coherent and darker than others, as they seem more matured, all composed of minute oil-cells, more or less disintegrated and reducible to simple cells intermixed with black atoms: it therefore becomes a question whether the reproductive power of these seeds resides in these cells or in these atoms. The latter view seems more probable, from their resemblance to the sporidia of Acrogens. But as the latter generate plants of a very low order of development, being deficient of flowers, wanting calyx, corolla, stamens, ovaries, and seeds, while the former produce plants endowed with perfect flowers, such atoms should bear the more appropriate name of blastidia, bearing the same relation to protoblasts that sporidia do to spores.

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[*] Ann. Nat. Hist. 3 ser. ix. 429: Contributions to Botany, ii. 146.

[†] Archiv. Mus. ix. 31, pl. 5. B. 4.

[‡] Dr. Hooker mentions, in a note (*l. c.* p. 17), that Hofmeister had observed a pollen-tube in the ovule of *Cynomorium*. Mr. Brown also saw a similar filament in the ovule of an Orchid, and showed that it was not a pollen-tube: his description of it quite coincides with that of the confervoid filament figured by Prof. Henfrey, which he traced and found to be a cellular elongation of the embryo-sac of the ovule in *Orchis* (Linn. Trans. vol. xxi. tab. 2. fig. 27), and which he states is the same "which Schleiden has certainly mistaken for a pollen-tube" (*loc. cit.* p. 9).

The evidence here adduced concerning *Myostoma*, as well as that advanced on previous occasions respecting other genera of the *Burmanniaceæ*, added to the valuable information which I have quoted regarding the *Balanophoreæ*, *Rafflesiaceæ*, &c., all combine to show that all these families, including the *Triuridaceæ*, constitute a special alliance, and that the Rhizogens, as a class, stand preeminently distinct from all others, on account of the peculiar organization of their seeds, the unusual mode of their germination, and perhaps not less abnormal manner of the fertilization of their ovules. Under this view the *Burmanniaceæ* would stand at the head of this class, because of their hermaphrodite and more perfect flowers, and the more complete development of all their parts; they would stand next to *Cytinaceæ* on the one hand, and touching *Orchidaceæ* on the other. But whether the latter family belongs to the same class has yet to be determined; in external appearance, their seeds offer much resemblance to those of the *Burmanniaceæ*, having a similar lax outer integument, enclosing a nucleus, the nature of which, as far as I can judge, seems yet involved in much obscurity*.

Griffiths concluded that *Thismia* should be placed in a position between *Burmanniaceæ* and *Taccaceæ*; but it appears to me to have little relationship with the latter family. Endlicher arranged the *Burmanniaceæ* after *Taccaceæ*, between *Hydrocharideæ* and *Iridaceæ*. In the systematic plan of Dr. Lindley, this family stands between *Marantaceæ* and *Orchidaceæ*. Formerly I pointed out the analogies existing on the one hand to *Triuridaceæ*, and on the other to *Orchidaceæ*. Prof. Agardh so far agrees in placing the *Thismieæ* next to *Orchidaceæ*; but he separates them from *Burmanniaceæ*, and disputes any analogy between them and *Taccaceæ*. The views of this author, however, set at defiance the opinions of all other botanists in regard to the general affinities of the *Burmanniaceæ*; for he places in one alliance *Saurureæ*, *Begoniaceæ*, *Melastomaceæ*, *Pentaphragmeæ*, *Gesneraceæ*, *Orobancheæ*, *Burmanniaceæ*, *Thismieæ*, *Orchidaceæ*, and *Cytinaceæ*, separating and associating in another, distant alliance *Balanophoreæ*, *Hydnoreæ*, and *Rafflesiaceæ*, which he couples with *Taccaceæ*, *Araceæ*, *Aristotelieæ*, *Lardizabaleæ*,

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* The best accounts of the earliest development of the ovule in *Orchideæ*, the circumstances seen about the period of its impregnation, and of its progressive growth, are those of Mr. Brown and Professor Henfrey, to which I have already referred; but, notwithstanding the copiousness of their details, neither of them indicate the nature of the really acting force which gives vitality to the nascent embryo, and both fail in showing the internal structure of the seed. I am therefore justified in making the above remark, as we have yet much to learn concerning the subject.

and others. It needs no argument to prove the utter incompatibility of alliances of such loose and heterogeneous affinities.

MYOSTOMA, gen. nov.

Flores hermaphroditi. *Perianthium* gamophyllum, tubulosum, imo ovario adnatum, tubo regulari, subcylindraceo, sulcato, supra medium ampliore, ad faucem breviter constricto, limbo 6-partito, segmentis 3 angustissime linearibus, marginibus valde revolutis et hinc subulatis, carnosis, infra faucem enatis, omnino exterioribus, tubo paulo brevioribus, patentim radiatis et subreflexis, 3 alteris alternis, orbiculatis, convexis, imo auriculato-cordatis, et late breviter unguiculatis; marginibus valde imbricatis, apice fornicatis, et faucem semper claudentibus. *Stamina* 6, æqualia, remote discreta, segmentis opposita; *filamenta* brevia, subfiliformia, fauci affixa, pendentia vel axin versus conniventia; *connectivum* longiter triangulare, extremitate angustatum et obtusum, ex adverso truncatum, ad angulos in cornua 2 erecta expansum, et inter cornua ex apice filamenti suspensum; *anthera* biloba, lobis lineari-oblongis, discretis, parallelis vel paulo divergentibus, dorso omnino adnatis, extrorsum spectantibus, sulcatis, et medio septulo longitudinali bilocellatis, hinc bivalvatim dehiscentibus. *Pollen* simplex, globosum, pallide stramineum, membrana tenuissima minute reticulata pustulis 3 hyalinis pertusa. *Stylus* brevis, teres, e disco erectus. *Stigma* stylo æquilongum, subito incrassatum, profunde 3-fissum, lobis curvatim erectis, subacutis, subtriquetris, intus planis, extus angulosis, undique papillosis. *Ovarium* inferum, turbinatum, 6-sulcatum, disco epigyno coronatum, 1-loculare, pluriovulatum; *ovula* numerosissima, ad placentas 3 parietales paulo supra basin breves crebre aggregata. *Capsula* turbinato-campanulata, hyalina, carnosa, post circumscissionem et lapsum perianthii ore omnino aperto. *Semina* numerosissima, minima, funiculis longiusculis e placentis suspensa, crebre intertexta, et fundum loculi implentia; *integumentum externum* oblongum, tenuissime membranaceum, laxum, longitudinaliter carinato-nervosum, nervis parallelis circa 12 e summo ad basin fissilibus, hinc valvatim solubile, interstitiis hyalinis, lineis obliquis crebre striatis, ad imum pulvino parvo reticulato notatum, ore late apertum; *integumentum internum* brevius, ovatum, integrum, membranaceum, reticulatum, nucleum arcte tegens; *blastidium* (nucleus) torulosum, in corpuscula plurima inæqualia solubile, *corpusculis* sine perithecio proprio e cellulis aggregatis oleaginis fusco-brunneis atomisque nigris sporuloideis compositis, *embryone* visibili nullo.—Plantula *Brasiliensis, humilis, hyalina: rhizoma tuberosum, fibrillosum; caulis simplex, sulcatus, erectus*; foliola *pauca, minima, bracteiformia, acuta, terminalia, sessilia, imbricatim decussata*; pedunculus *solitarius, terminalis, cauli similis, intra foliola enatus, primum brevis, demum elongatus, ebracteatus, 1-florus*; flos *hyalino-albidus, erectus.*

MYOSTOMA HYALINUM, nob.: tubere parvo, noduloso, fibrillifero; caule nudo, sulcato, hyalino; foliolis 4, bracteiformibus, albidis, sessilibus, acutis, erectis, per paria oppositis, imbricatim decussatis, imo fere vaginatim nexis, persistentibus; pedunculo intra foliola enato, brevi, caulis diametro et demum tertia parte ejus longitudinis; flore solitario, terminali, carnosulo, tubo hyalino, ore pallide aurantiaco; capsula hyalina, demum cupulari. In Brasiliæ montibus Organensibus, circa Petropolin.

This plant was found by my son, in March 1862, in the virgin forests near Petropolis, at an altitude of about 3000 feet above the level of the sea. He found only a single cluster of these plants, growing in a damp mass of dead leaves, which carpeted the middle of a small open space about 12 feet wide, overshadowed by lofty trees. The tubers, with their fibres, did not appear attached to the roots of the surrounding trees, but simply imbedded in the decaying leaves. It was under precisely similar circumstances that I found the plants of *Triuris* in the year 1837. The stem is from 2 to $3\frac{1}{2}$ inches long, half

a line thick, surmounted by four bracteiform leaflets, 2 lines long, 1 line broad, in decussate opposite pairs. The pedicel, in flower, seldom exceeds half an inch, but ultimately grows to a length of an inch; the tube of the perianth is 4 lines long, 3 lines in diameter in the middle, and suddenly contracted for a short space to a breadth of 2 lines; the three inner segments are 3 lines in diameter, auricularly cordate at base, where they are furnished with a short claw 1 line broad, attached to the edge of the throat; the three outer alternate segments originate a little below the contraction of the throat, are 4 lines long, half a line thick, in their coiled state somewhat subulate, at first horizontal, but soon curving downward; the filaments, pendent from the throat of the perianth, are opposite the segments, half a line long, the connective being of the same length, and its two erect horns equally long; the style and stigma are each half a line long; the capsule 3 lines long, and 3 lines broad across its mouth.

DESCRIPTION OF PLATE LVII.

Fig. 1. Entire plants of *Myostoma hyalinum* in flower and in seed, natural size.
Fig. 2. A flower, with a portion of the stem, showing the leaves, magnified.
Fig. 3. A longitudinal section of the same, showing the position of the stamens, style, stigma, and two of the parietal placentæ, with the seeds removed.
Fig. 4. An inner segment of the border, outside and inside view.
Fig. 5. Transverse section of one of the outer segments of the border.
Fig. 6. A stamen seen from within, more magnified.
Fig. 7. The same seen sideways.
Fig. 8. The same on the side facing the perianth, showing the extrorse anthers.
Fig. 9. A grain of pollen, very highly magnified.
Fig. 10. The capsule seen from above, showing the position of the placentæ, natural size.
Fig. 11. A capsule, with the contained seeds, magnified.
Fig. 12. Seeds, a little magnified.
Fig. 13. A seed suspended by its funicle, much magnified.
Fig. 14. A portion of the funicle, very highly magnified.
Fig. 15. The outer integument, showing the manner in which it splits by pressure, the included nucleus having been removed, much magnified.
Fig. 16. The nucleus, after removal.
Fig. 17. The integument of the nucleus after the contents are removed.
Fig. 18. The contents of the same, consisting of several irregular spherules, all magnified on the same scale.
Fig. 19. One of the spherules, more magnified.
Fig. 20. The minute oily globules and sporule-like atoms, into which the spherule is resolved by pressure, highly magnified.

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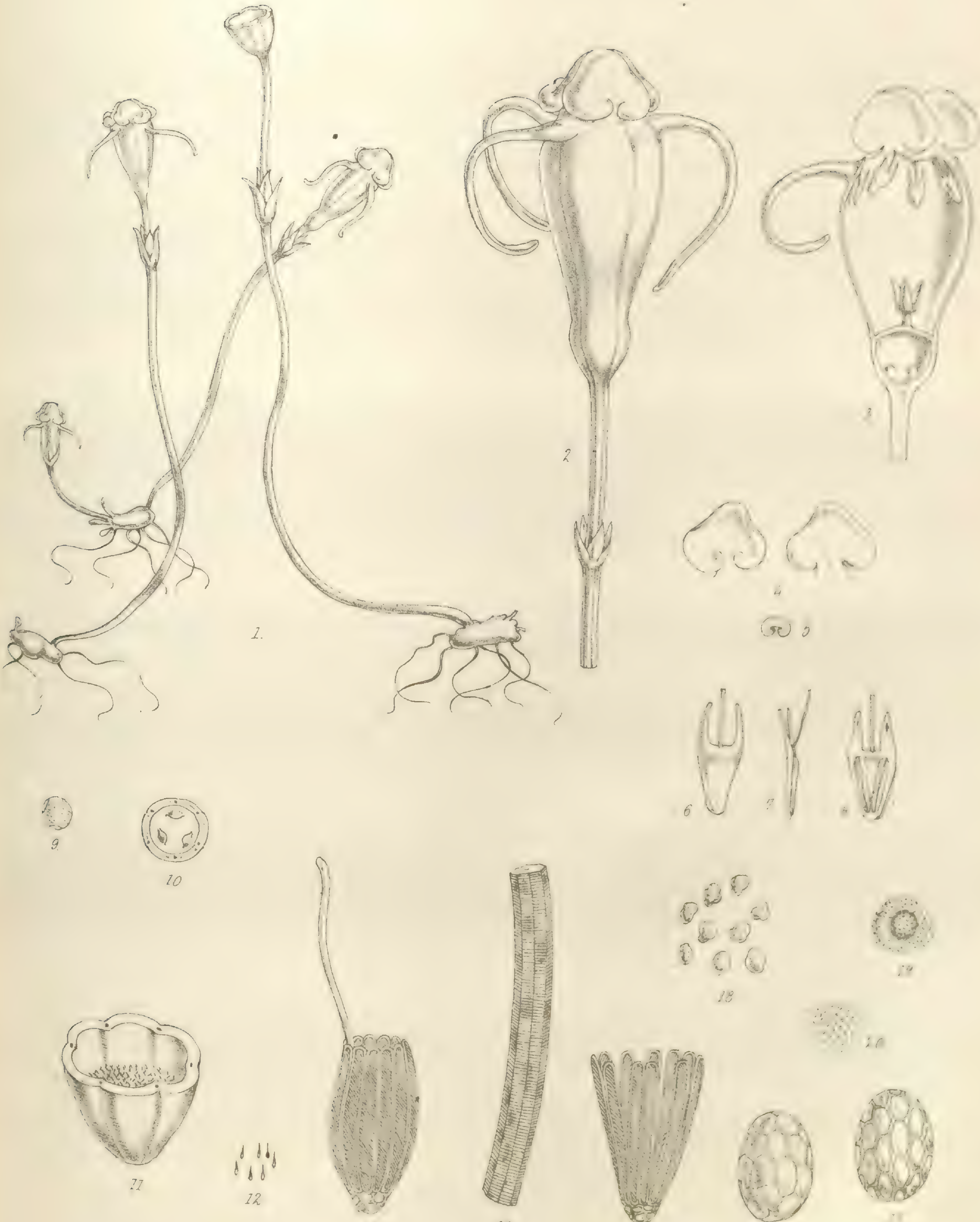
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J. Miers del. Fitch lith.

J. N. Fitch imp.

XIX. *On the Development of Chloëon (Ephemera) dimidiatum.*

By Sir John Lubbock, *Bart., F.R.S., V. P. Linn. Soc., Pres. Ent. Soc., V. P. Eth. Soc. &c.*

(Plates LVIII. & LIX.)

PART II.

Read December 21st, 1865.

THE Linnean Society have done me the honour of publishing, in the 2nd part of the 24th volume of their Transactions, a memoir on the development of a very common freshwater larva—that, namely, of *Chloëon dimidiatum.*

I traced it through seventeen stages, and described the gradual alterations which it underwent. The object of the present communication is, in the same manner, to describe the subsequent and very remarkable changes which take place during the development of the perfect insect.

As will be seen from the Table given at the end of this memoir, the changes of skin during the winter months are separated by longer intervals than is the case in other periods of the year, and sometimes two or even three moults will take place without any material change of form. In December, January, and February there are generally at least 14 (and sometimes as many as 30) days between each moult. Thus a specimen which on the 6th of November entered the 17th stage remained without any material change until the 18th of January, during which period it changed its skin four times, at intervals respectively of 19, 16, 19, and 19 days. My different specimens, however, did not appear to agree exactly as to the number of moults.

Eighteenth State.

The wing-cases now cover the whole of the first abdominal segment, and the length of the body is on an average about $\frac{6}{20}$ of an inch. The segments which compose the antennæ and the caudal appendages continue to increase in number; but it is very difficult to obtain specimens in which these organs are perfect; nor when this is done can the number of segments be very easily determined. Plate LVIII. fig. 1 represents part of the basal portion of one of the caudal appendages, and shows the steps in the process by which the segments are formed. Probably no two observers would exactly agree as to the number of segments which compose one of these organs.

The anterior plate of the anterior branchia is now about as long as the other, and somewhat broader than in the preceding state.

Hitherto all the specimens of the species have resembled one another; but about this period of development the external sexual characters of the males begin to show themselves. Between the two large original eyes we now see indications of a second pair, the rudiments of the two great pillared eyes. In the cast skin we may see that the chitinous head-covering has here undergone a change. The skin is neither divided into the more or less regularly hexagonal facets of the original eye, nor does it present the irregular polygons which mark the upper part of the head; on the contrary, it is marked by a great number of small wedge-shaped dots, which divide it into minute fields, the future facets. These incipient eyes lie close to the others, occupy already a considerable part of the top of the head, and are of an elliptic form.

The second character of the male sex occurs on the underside of the penultimate abdominal segment, the outline of which now presents two very slight projections, which are of importance only as indications of future changes. The females do not appear to present the slightest trace either of these processes or of the pillared eyes.

In the female, the commencement of the ovaries may now be observed, in the form of two cylindrical organs, one on each side of the abdomen. They consist of a central tube with short lateral lobules.

Nineteenth State.

The wing-cases now cover about half of the second abdominal segment, and the insect is about $\frac{1}{3}$ of an inch in length. The antennæ and caudal appendages have again increased in length and in the number of the segments.

The pillared eyes are somewhat more developed, but the facets are still indicated only by the arrangement of the dots. They are about $\frac{2}{7000}$ of an inch in diameter, which is half that of the other eyes.

The anterior plate of the anterior branchia is somewhat longer than before, but there is no great alteration.

The small projections on the underside of the penultimate abdominal segment are rather more developed, but there is no great change in them.

The rudimentary ovaries are somewhat more developed.

Twentieth State.

In this stage, which is the last passed under water, the rudimentary wings cover half of the third abdominal segment, or, in some cases, the whole. The facets of the "pillared eyes," which are characteristic of the male, are still indicated by dots; the facets of the ordinary eyes seemed to me to be more sharply defined than before.

The anterior gills are but little altered.

The antennæ are now far longer than they will be in the next state. This is interesting, as showing that the changes which have taken place in them are not mere stages in the development of the perfect form, but are adapted for some special object, which we have not yet determined. It may be thought that long antennæ, like those of the full-grown larva, would be an encumbrance to flight, and that for this reason they are shortened in the imago; but, on the other hand, it might be said with an equal appearance of probability, that they would be inconvenient for swimming. However this may be, the fact remains, and I was interested to see in what manner the change was effected. This is shown at a glance by Plate LVIII. fig. 2, in which we see that the antenna of the proimago is not only much shorter, but also thinner than that of the present stage, in which it lies like a sword in its sheath. The two basal segments (Plate LVIII. fig. 2 *a*), indeed, are almost filled by the new organ, but this is far from being the case with the thirteen following. In this portion of the antenna (Plate LVIII. fig. 2 *b*), the chitinogenous layer and the soft internal tissues have contracted very much, so that the new antenna lies quite loosely in the old one. It only reaches, however, as far as the fifteenth segment. From this part onwards (Plate LVIII. fig. 2 *c*) the softer tissues of the old antenna are unaltered, they take no part in the formation of the new organ, and when the skin is shed they are cast off with the dead outer layer of the chitine. The connexion between the antenna of the proimago and the tissue of the terminal part of the antenna is shown in Plate LVIII. fig. 3.

The mouth-parts do not essentially differ from the description of them given by Westwood ('On the Modern Classification of Insects,' vol. ii. p. 24).

The *upper lip* (Plate LVIII. fig. 4) is almost quadrangular, rounded off at the free angles, and notched in the middle of the anterior border. It has a number of short hairs along the margin, and a few others scattered over the surface.

The *mandibles* (Plate LVIII. fig. 5) are short, strong, and horny. The free edge may be divided into three very distinct parts. The upper portion is divided into three processes, each of which has two or three teeth. The middle portion is occupied by a tuft of hairs. The basal part under a low power has a molar appearance, but when highly magnified is seen to be set with the curious processes two of which are figured (Plate LVIII. fig. 6), one seen sideways, the other looked at from in front. As usual, the mandibles are slightly unsymmetrical; and one of them has a strong process at the upper end of the molar portion.

The *maxillæ* (Plate LVIII. fig. 7) are short, slightly curved, with two strong teeth, and a row of spines along the upper inner edge. The palpi are rather longer than the maxillæ themselves, and have three joints. According to Westwood the corresponding organ of *E. vulgata* consists of four segments: comparing his figure with my specimens, it seems that the small basal segment is undifferentiated. The two apical segments are also less distinctly separated than in his figure.

The *lower lip* (Plate LVIII. fig. 8) is membranous and deeply quadrifid. The palpi are three-jointed; but the division between the two terminal segments is not strongly marked. Mr. Westwood says that the lower lip is "furnished within with a broad tongue, of which the anterior angles are produced and pilose;" I found, indeed, in addition to the organs already described a three-lobed membranous lip (Plate LVIII. fig. 9), which I presume to be the tongue. It seemed to me, however, to lie in front of the mouth and to be connected, not with the labium, but with the labrum. Possibly it may be homologous with the membranous lobes in the Thysanura, which I have doubtfully suggested to represent a second pair of maxillæ (?).

The small projections on the penultimate abdominal segment of the males are slightly larger, and contain the ends of the two lateral appendages, which towards the end of this period can be distinctly seen through the skin.

The ovaries are two white cylindrical bodies, which occupy the whole length of the abdomen. They consist of a great number of short egg-tubes, each of which is divided into two chambers (Plate LVIII. fig. 10). The upper chamber contains a number of vitellogenous cells; it is elongated and more or less cylindrical in form, terminating at the upper end, as usual, in a delicate string.

The lower chamber is elliptic, and contains numerous oil-globules, some of large size. It has a greenish hue, caused by the presence of numerous small globules.

The Organs of Respiration.

It has been already mentioned that the larvæ in the first three stages possess no respiratory organs whatever. This is a fact so exceptional that, so far as I am aware, no other case is on record. Even the youngest larvæ have hitherto been invariably found to possess tracheæ, and either spiracles or gills, as the case might be. We are apt to be surprised by anything which is unusual; but in reality it appears more difficult to understand why these larvæ should not respire in the same manner as the Crustacea with which they live during the whole of their subaqueous existence, than why they should do so for a short part of it.

Another unusual fact connected with the tracheæ of Chloëon is, that their internal chitinous envelope is not shed with the skin. In ordinary larvæ the inner skin of the tracheæ is shed at each moult, it being drawn out through the spiracles. That the same is not the case in Chloëon depends evidently on the absence of spiracles, so that the shedding would be a physical impossibility. The necessity for a change ceases, however, with the possibility. Where there are open spiracles, dust, &c. must occasionally enter, in spite of the tufts of hair and other ingenious contrivances by which it is to a great extent excluded. At every change of skin, however, all foreign matters are necessarily carried away with the tracheal skin, and the passage is thereby kept free and open. Where, on the other hand, as in the larva of Chloëon, there are no orifices, no foreign matters can possibly enter, and the necessity for changes of skin is perhaps thereby removed.

When, however, the insect changes into the proimago and quits the water, spiracles are formed; and at this moult, for the first time, the inner skin of the tracheæ is cast, as is the case in other insects.

Dr. Hagen has recently published a posthumous memoir by Prof. Rathke [*], a translation of which has appeared in the 'Annals and Magazine of Natural History' (ser. 3. vol. ix.) In this paper Prof. Rathke expresses opinions, as to the manner in which the respiration of insects is carried on, which are very opposite to those which I have advocated in my memoir "On the Tracheæ of Insects," published in the Transactions of this Society for 1860.

Dr. Rathke, after describing the so-called respiratory movements of insects, discusses the function which they perform.

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[*] Schriften der Königl. physik-ökonom. Gesellschaft zu Königsberg, 1861, p. 99.

"The pulsation," he says, "of the dorsal vessel cannot be essentially affected by these movements, as, when they cease for a longer or shorter time, the activity of the dorsal vessel does not stop. This applies also to the action of the digestive organs: for this likewise goes on, and movements (especially peristaltic) of the intestine and malpighian vessels take place, even when the movements of the abdomen cease for some time. There can also be no particular relation between them and the function of the generative organs, as they occur both when the sexual organs are far from maturity and when their activity appears to be purely plastic. There are no other organs in the abdomen of most insects, except the respiratory organs, with which these movements can be connected;" and he concludes, therefore, that the function of their movements is to produce a change of air in the tracheæ, and that, "from the absence of all such phenomena we might conclude that in the pupæ of the above-mentioned insects (Beetles and Hymenoptera) the tracheary respiration is entirely interrupted"*.

But in the paper above mentioned, I have shown that the mode in which the tracheæ branch offers no support to the idea of any circulation of air, while the fact that they end in long blind extremities seems to be fatal to any such hypothesis. Under these circumstances, it occurred to me, as indeed had been suggested long before by Dr. Graham, that the interchange of air was effected by virtue of the diffusion of gases. I see no reason to change this opinion, which, moreover, receives very strong support from the arrangement of the respiratory organs of the Chloëon-larva and other aquatic larvæ which respire by means of gills. Here there are no external openings, consequently there can be no inspiration or expiration of air; and yet it is evident that the respiration is not interrupted.

I will not deny that in aërial insects a partial change of the air in the larger tracheæ may be effected by the "respiratory" movements, nor will I assert that there are "any other organs in the abdomen" . . . . . . with which these movements can be connected. But it seems very possible that they may tend, and be intended, to assist the weak "dorsal vessel" in producing the circulation of the blood.

In considering the gills, it is remarkable how small a portion of the surface is occupied by the tracheæ. Plate LVIII. fig. 11 represents a portion of the anterior gills; and it will at once be seen how large a part of the surface is apparently wasted. This is a fair example, and quite as richly supplied with air-vessels as is usual. It was copied immediately after the death of the insect, and before any material change had taken place. In younger larvæ it might be said that the organ was partially embryonic, and that the large extent of membrane was in preparation for a richer network of tracheæ. As, however, we have now reached the definite condition of these gills, which will be thrown off at the next change of skin, this argument does not apply. Nor is this an exceptional case; the same poverty, if I may use the expression, is visible in the corresponding organs of other water-insects, and may perhaps be taken as collateral evidence that the true *modus operandi* of these organs is not yet perfectly understood—and the more so if we bear in mind the richness in blood-vessels of the lungs of higher animals.

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* Ann. & Mag. Nat. Hist. ser. 3. vol. ix. pp. 95, 105.

Possibly one principal function of the branchiæ is to produce constant currents, thereby bringing fresh supplies of water into contact with the general surface of the skin, through which doubtless much of the respiration is carried on.

On the other hand, there are species to which (as, for instance, is the case with *Ephemera vulgata*) this argument does not apply.

According to Rathke, "the muscles by which these movements are produced are exceedingly simple. Each segment which takes part in it is furnished only with a single pair of muscles for this purpose, each of which is attached by one end to the lateral wall, and by the other to the dorsal wall or plate, in both places close to the soft parts of the cutis"*.

In the same manner Chabrier † tells us that the wing-muscles do not (except apparently among the Libellulidæ) act *directly* on the wings, "mais ils les meuvent par l'intermédiaire du dorsum et par d'autres leviers particuliers." Some light seems to be thrown on this remarkable fact by the above-mentioned statement of Rathke; and the movement of the branchiæ in aquatic larvæ forms a connecting link between the two, and throws some light on the curious arrangement of the muscles observed by Chabrier.

The Digestive Organs.

The œsophagus is very short indeed, and expands immediately behind the head into the stomach, for which there is plenty of room even in the thoracic segments, owing to the weakness of the legs and the smallness of the muscles by which they are moved. The ilium is quite short and well rounded. The rectum is rather longer, and cylindrical. The Malpighian vessels are numerous and short. They open as usual into the posterior end of the stomach. According to Burmeister the Neuroptera have six Malpighian vessels; in this species they are, however, more numerous and of a somewhat peculiar form, consisting of two parts, which are about equal in length. The distal portion consists of a thin cylindrical tube. The other half is shaped like a long club, to the broad end of which the cylindrical tube or efferent duct is attached. Swammerdam (Bib. Nat. plate xv. fig. 5), who is quoted by Ramdohr (Verdauungswerkzeuge der Insekten p. 151), does not figure or mention any Malpighian vessels. It is true that his observations did not refer to the same species as mine; but it seems unlikely that the different species of *Ephemera* should differ from one another in a point of so much importance. The Malpighian vessels are formed of nucleated cells in the usual manner. Under the action of acetic acid, they become quite transparent.

The food consists principally of minute Diatomaceæ. Swammerdam, indeed, says that the larvæ of the Ephemeridæ feed on mud; but this is probably a mistake arising from the small size of the Diatoms and the low powers used by him. Still it is quite possible that it may be true of the species examined by him. Other species, again, according to Pictet, are insectivorous.

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* *Loc. cit.* p. 83.

† Vol des Insectes, p. 33.

Proimago.

One morning in June I observed a full-grown larva, which had a glistening appearance, owing to the presence of a film of air under the skin. I put it in my microscope, under a low power; and then, having added a drop more water with a pipette, I put the instrument down, and looked through the glass. To my astonishment, the insect was gone, and an empty skin only remained. I then caught a second specimen in a similar condition, and put it under the simple microscope, hoping to see it come out. Nor was I disappointed: very few moments had elapsed when I had the satisfaction of seeing the thorax open along the middle of the back; the two sides turned over, the proimago literally walked out of itself, unfolded its wings, and in an instant flew up to the window.

Several times since, I have had the pleasure of witnessing this wonderful change; and it is really extraordinary how rapidly it takes place; from the moment when the skin first cracks, not ten seconds are over before the insect has flown away. For some little while before the change the larva is rather helpless; but this is of the less importance, because this larva is not obliged, like many others, to leave the water before it emerges. Owing to the production of air between the old and new skins, it naturally comes to the surface; and it is probable that the quantity of air between the folds of the wings brings the back of the thorax uppermost. When the larval skin has burst and folded itself back, it acts for the moment as a raft.

The antennæ are as in Plate LVIII. fig. 2 *a* & *b*; they consist of a basal portion formed by two segments, and succeeded by an unjointed whiplike part, which has a very curious appearance, the whole surface being covered by small but well-marked ridges, which include small angular areas. Zaddach maintains that the antennæ of the imago are not homologous with those of the larvæ; but it is evident that in *Ephemera*, at least, there is no such difference.

The pillared eyes of the male are brown, but each has a pale band running round it just below the crown. The three ocelli have not changed much in appearance. On the top of the head, between the two large eyes, the male has two rounded eminences, which occupy the places where two new eyes will, in the perfect imago, make their appearance.

The feet of all the three pairs are similar (see Plate LIX. fig. 12, which represents the first pair). The tarsi are four-jointed; the last bears a soft rounded pad, which might be described as a fifth tarsal segment. In the two posterior pairs of legs, the third tarsal segment is shorter than the others. The claw is quite small, and does not project beyond the terminal pad. There are no long hairs on the legs, which are covered, however, by short ones; those on the tarsus are stiff, and almost deserve the name of spines. The skin of the tarsal segments is thrown into small ridges like those on the antennæ.

The wings are of a dusky hue. They are covered by minute hairs, and are fringed along the hinder edge (Plate LIX. fig. 13). This appears to be the case also with most, if not all, of the other species of the group.

The caudal filaments are about $\frac{1}{2}$ an inch in length; near the base they are $\frac{1}{180}$ of an inch in thickness; but they gradually taper to the free end, where they are only $\frac{1}{600}$, ending finally in a blunt point. The segments at the base are about $\frac{1}{150}$ of an inch in length, but they increase somewhat towards the free end. There are no longer any fringes; but the whole surface is covered with short, equidistant, strong, pointed hairs. The middle tail of the larva is represented by a short conical appendage.

The sexual appendages of the male (Plate LIX. fig. 14) are four-jointed. The two basal segments are short and broad; the third is cylindrical, $\frac{1}{80}$ of an inch in length. The terminal segment is small. The whole organ is covered with minute hairs. These organs are absent in the female.

Imago.

The two great pillared eyes (Plate LIX. fig. 15) at once distinguish the male from the female. In the latter they are entirely absent: in the former they occupy almost the whole top of the head; and the larval eyes, which do not appear to have undergone any great change in appearance, are thrown entirely to the side. The pillared eyes are facetted only on the flat summits. The antennæ resemble those of the proimago.

The anterior legs of the male (Plate LIX. fig. 16) are elongated, though not so much so as in some other species. The tarsal segments, which are four in number, decrease in length from the first to the last, which bears a single claw. The two posterior pairs more closely resemble those of the proimago, and, like them, have the third segment shorter than the terminal one. The third pair terminates in a pad and a claw (Plate LIX. fig. 17). The skin of the legs resembles that of the proimago.

The wings are paler and more delicate than those of the proimago. There are no hairs, nor is there any fringe on the hinder margin (Plate LIX. fig. 18); but the nervures are more sharply defined. The shape of the wings and the arrangement of the nervures has undergone little change.

It is difficult to understand the cause of the differences which exist between the wings of the proimago and those of the imago. They are not confined to this species, but appear to be general to the whole group. In *Palingenia virgo*, indeed, the posterior margin bears a row of hairs; but even in this species they are quite unlike those of the proimago.

The two tails are of considerable length, and consist of a number of segments. They are near the base, about $\frac{1}{360}$ of an inch in thickness, and each segment has a length of from $\frac{1}{180}$ to $\frac{1}{120}$ of an inch. Instead of the long fringes which were present in the larvæ, and which may be supposed to have been of assistance in swimming, the whole surface of the caudal appendages in the imago is covered with short, stiff, pointed hairs, which are all of nearly the same size.

The appendages are pale in colour; but the joints are dark brown, which gives them a ringed appearance. Sometimes every second joint is darker than the rest.

The perfect insect makes its appearance in June.

In my previous memoir I referred the above insect, on the authority of Mr. Walker, to *Chloëon dimidiatum*. Since then I have also forwarded specimens to Mr. M'Lachlan, who has devoted much time to the examination of this family, and who confirms the opinion of Mr. Walker. The group, however, much wants a careful revision.

Curtis's description of *Chloëon dimidiatum* is as follows:—"Length 3 lines. Castaneous brown; collar with an ochreous dot on each side; abdomen, especially at the base, banded with ochre; filaments very long and white, remotely dotted with black; legs straw-colour; nervures of wings very faint."—*Phil. Mag.* 1834, p. 121.

Having thus traced up, step by step, the history of this insect from a period when it is no more than $\frac{1}{40}$ of an inch in length until its appearance in the perfect state, I will, in conclusion, say a few words on the general subject of insect-metamorphoses. The two points to which I would particularly call the attention of entomologists are:—

First, the gradual changes which are undergone by these larvæ. We shall, I believe, find the same to be the case with other larvæ of the homomorphous series of insects.

And, secondly, the fact that many of these changes bear no reference to the ultimate form of the insect, but are connected with the conditions in which the larva itself is placed.

Moreover I have called attention to the fact that there are certain differences even between the proimago and the imago. These, indeed, are not extensive; the mere presence or absence of minute hairs on the surface of the wing, and of a fringe on its posterior margin, may not seem in themselves at first sight to be points of much interest or importance; when, however, they are taken in conjunction with the changes which occur in the antennæ, with the formation and subsequent disappearance of the branchiæ and middle tail, as well as with other similar facts which have been recorded in this memoir, they appear to suggest considerations of much interest.

The larvæ of insects are generally regarded as being nothing more than immature states, as stages in the development of the egg into the imago; and this might more especially appear to be the case with those insects in which the larvæ offer a general resemblance in form and structure (excepting of course so far as relates to the wings) to the perfect insects. Nevertheless we see that this would be a very incomplete view of the case. The larva and pupa undergo changes which have no relation to the form which they will ultimately assume. With a general tendency, as regards size and the production of wings, to this goal, there are combined other changes bearing reference only to their existing wants and condition.

Nor is there in this, I think, anything which need surprise us. External circumstances act on the insect in its preparatory states as well as in its perfect condition. Those who believe that animals are susceptible of great, though gradual, change through the influence of external conditions, whether acting, as Mr. Darwin has suggested, through natural selection, or in any other manner, will see no reason why these changes should be confined to the mature animal. And it is evident that creatures which, like the majority of insects, live during different periods of their existence in very different circumstances, may undergo considerable changes in their larval organization, in consequence of forces acting on their larval condition, not, indeed, without affecting, but certainly without affecting to any corresponding extent, their ultimate form.

We can in this manner, I think, understand those cases in which animals, very similar in their mature condition, are very unlike in their earlier stages.

The question still arises, Why do insects pass through metamorphoses? Messrs. Kirby and Spence tell us that they "can only answer that such is the will of the Creator"*,—

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* 'An Introduction to Entomology,' sixth edition, vol. i. p. 61.

which, however, is rather a general confession of faith than an explanation of metamorphoses. And this they appear to have felt themselves; for they immediately proceed to make a further suggestion. "Yet one reason," they say, "for this conformation may be hazarded. A very important part assigned to insects in the economy of nature, as I shall hereafter show, is that of speedily removing superabundant and decaying animal and vegetable matter. For such agents an insatiable voracity is an indispensable qualification, and not less so unusual powers of multiplication. But these faculties are in a great degree incompatible; an insect occupied in the work of reproduction could not continue its voracious feeding. Its life, therefore, after leaving the egg, is divided into three stages."

But there are some insects, as, for instance, the Aphides, which certainly are not among the least voracious, and which eat and breed at the same time. There are also many scavengers among other groups of animals, such, for instance, as the dog, the pig, and the vulture, which undergo no metamorphosis.

It is certainly true that, as a general rule, growth and reproduction do not occur together; and it follows, almost as a necessary consequence, that in such cases the first must precede the second. But this has no immediate connexion with the occurrence of metamorphoses. The question is, not why an insect does not generally begin to breed until it has ceased to grow, but why, in attaining to its perfect form, it passes through such remarkable changes. And in addition to this, we must consider, first, the sudden and apparently violent nature of these transitions, and, secondly, the immobility of the animal in its pupa state; for undoubtedly the quiescent and deathlike condition of the pupa is one of the most remarkable characteristics of insect-metamorphosis.

First, then, the necessity for change depends on the fact that most insects leave the egg in a very early condition*. The Orthoptera, indeed, and other homomorphous insects, are hatched in a more advanced form, and consequently undergo fewer subsequent changes than is the case with other insects. Those processes, however, of evolution which take place in the egg itself attract comparatively little attention, even among entomologists.

We may now pass to the second part of the subject—that is to say, the apparently sudden and abrupt nature of the changes which insects undergo. I say "apparently," because the changes in the internal organs, though rapid, are in reality gradual; and even as regards the external form, though the metamorphosis may take only a few minutes, this is but the change of outer skin—the drawing away, as it were, of the curtain; and the new form which then appears has been in preparation for days or, perhaps, weeks before.

Swammerdam, indeed, supposed (and his view was adopted by Kirby and Spence†) that the larva contained within itself "the germ of the future butterfly, enclosed in what will be the case of the pupa, which is itself included in the three or more skins, one over the other, that will successively cover the larva." This is entirely a mistake; but it *is* true that, if you examine a larva shortly before it becomes a pupa, you will find that the skin is loose, and that within it the future pupa may be traced. In the same manner, if you examine a pupa which is about to disclose the butterfly, you will find the future insect, soft indeed and imperfect, but still easily recognizable, lying more or less loosely within the pupa-skin. More than one such inner skin, however, is never present.

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* And this, again, is probably owing to the fact that the amount of nourishment in the egg is insufficient to carry the insect to maturity.

† *Loc. cit.* p. 55.

One fundamental difference between an insect and a vertebrate animal is, that whereas in the latter, as for instance in ourselves, the muscles are attached to an internal bony skeleton, in insects no such skeleton exists. They have no bones, and their muscles are attached to the skin. Hence the necessity for the hard and horny dermal investment of insects, so different from the softness and suppleness of our own skin.

Moreover the result is, that without a change of skin a change of form is impossible. The chitine, or horny substance, forming the outside of an insect is formed by a layer of cells lying beneath it, and, once formed, cannot be altered. From this it follows that every change of form is necessarily accompanied by a change of skin.

In some cases, as for instance in *Chloëon*, each change of skin is accompanied by a small change of form, and thus the perfect insect is more or less gradually evolved. In others, as for instance in Caterpillars, several changes of skin take place without any alteration of form, and the change, instead of being spread over many, is confined to the last two moults.

Very little consideration will afford us an explanation of this difference. The mouth of the Caterpillar is provided with a pair of strong jaws, fitted to eat leaves; and the digestive organs are adapted for this kind of food.

On the contrary, the mouth of the butterfly is suctorial; it has a long proboscis, beautifully adapted to suck the nectar from flowers, but which would be quite useless, and, indeed, only an embarrassment to the larva. The digestive organs also are adapted for the assimilation, not of leaves, but of honey. Now it is evident that if the mouth-parts of the larva were gradually metamorphosed into those of the perfect insect, through a number of small changes, the insect would in the meantime be unable to feed, and liable to perish of starvation in the midst of plenty.

On the contrary, in the Orthoptera and, as a general rule, among those insects in which the changes are gradual, the mouth of the so-called larva resembles that of the perfect insect, and the principal difference is in the presence of wings.

Similar considerations throw much light on the nature of the chrysalis or pupa state—that remarkable period of death-like quiescence which is one of the most striking characteristics of insect-metamorphosis. The comparative quiescence of the pupa is mainly owing to the rapidity of the changes going on in it.

In the chrysalis of a butterfly, for instance, not only, as has been already mentioned, are the mouth and digestive organs undergoing change, but the same is the case with the muscles. The powerful ones which move the wings are in process of formation; and even if they were in a condition favourable to motion, still the nervous system, by which the movements are set on foot and regulated, is also in a state of such rapid change that it could scarcely act.

Finally, from the metamorphoses of insects we pass naturally to that most remarkable phenomenon which is known as the "Alternation of Generations," for the first systematic view of which we are indebted to my eminent friend Prof. Steenstrup.

I have always felt it very difficult to understand why any species should have been created in this double character; nor, so far as I am aware, has any explanation of the fact yet been attempted. Yet insects offer, in the metamorphoses which they go through, a phenomenon not altogether dissimilar, and give a clue to the manner in which alternations of generations may have originated.

The Caterpillar owes its difference from the Butterfly to the early stage at which it leaves the egg; but its actual form is mainly due to the influence of the conditions in which it lives. If the Caterpillar, instead of changing into one Butterfly, produced several Butterflies, we should have an instance of alternation of generations. Until lately, however, we knew of no such case; each larva produced one imago, and that not by generation but by development. It has long been known, indeed, that there are some species in which certain individuals remain always apterous, while others acquire wings. Many entomologists, however, regard these abnormal individuals as perfect though wingless insects; and therefore, though these cases appear to me to deserve more attention than they have yet received, I shall not build any argument on them.

Recently, however, Prof. Wagner, of Kazan, has discovered that, among certain small gnats, the larvæ do not themselves directly produce the perfect insect, but give rise to other larvæ, which undergo metamorphoses of the usual character, and eventually become gnats. His observations have been confirmed, as regards this main fact, by other naturalists; and there can, I think, be no doubt that they are in the main correct.

Here, then, we have a distinct case of alternation of generations, as characterized by Steenstrup. Probably other cases will be discovered in which insects undeniably in the larval state will be found to be fertile. Nay, it seems to me possible, if not probable, that some larvæ which do not now breed, in the course of ages may come to do so.

If this idea is correct, it shows us how the remarkable phenomenon known as alternation of generations may have originated. At any rate, we find among insects every mode of development, from simple growth on the one hand, to well-marked alternation on the other. In the wingless species of Orthoptera there is little difference, excepting in size, between the young larva and the perfect insect. The growth is as simple and gradual as in any other animal; and the creature goes through nothing which would, in ordinary language, be called a metamorphosis. In the majority of Orthoptera the presence of wings produces a marked difference between the larva and the imago. The habits, however, are the same throughout life, and consequently the action of external circumstances affects the larva in the same manner as the perfect insect.

This is not the case with the Ephemeridæ. The larvæ do not live under the same conditions as the perfect insects; external forces accordingly affect them in a different manner; and we have seen that they pass through some changes which bear no reference to the form of the perfect insect: these changes, however, are for the most part very gradual. The caterpillars of Lepidoptera have even more extensive changes to undergo; the mouth of the larva, for instance, is remarkably unlike that of the perfect insect. A change in this organ, however, could hardly take place while the insect was still growing fast, and consequently feeding voraciously. Nor, even if the change could be thus effected, would the mouth, in its intermediate stages, be in any way fitted for biting and chewing leaves. The same reasoning applies also to the digestive organs. Hence the caterpillar undergoes little, if any, change, except in size, and the metamorphosis is concentrated, so to say, into the last two moults. The changes then become so rapid and extensive, that the intermediate period is necessarily one of quiescence.

Owing to the fact that the organs connected with the reproduction of the species come to maturity at a late period, larvæ are generally incapable of breeding. There are, however, some flies which have viviparous larvæ, and thus offer a typical case of alternation of generations, owing to the early period of leaving the egg, and the action in many cases of external circumstances on the larva different from those which affect the mature form.

Thus, then, we find among insects every gradation, from the case of simple growth to that of alternation of generations; and we see how from the single fact of the early period at which certain animals quit the egg, we can account for the metamorphoses they go through, and the still more remarkable phenomenon that, among many of the lower animals, the species is represented by two very different forms. We may even, from the same considerations, see reason to conclude that this phenomenon may in the course of ages become still more common than it is at present. As long, however, as the external organs arrive at their mature form before the internal generative organs are fully developed, we have cases of metamorphosis; but if the reverse is the case, then alternation of generations often results.

The same considerations throw much light on the remarkable fact, that in alternation of generations the reproduction is always agamic in the one form. This results from the fact that impregnation requires the perfection both of the external and internal organs; and if the phenomenon arises, as has just been suggested, from the fact that the internal organs arrive at maturity before the external ones, impregnation cannot take place, and reproduction will result in those species only which have the power of agamic multiplication.

Moreover it is evident that we have in the animal kingdom two kinds of dimorphism. The term has usually been applied to those cases in which animals or plants present themselves at maturity under two different forms. The different forms of Ants and Bees afford us familiar instances among animals; and among plants the remarkable case of the genus *Primula* has recently been worked out with his usual ability by my friend Mr. Darwin. Even more recently he has made known to us the still more remarkable phenomenon afforded by the genus *Linum*, in which there are three distinct forms, and which therefore offers an instance of polymorphism*.

The other kind of dimorphism or polymorphism differs from the first in resulting from the differentiating action of external circumstances, not on the mature, but on the young individual. The different forms, therefore, stand towards one another in a relation of succession. In the first case the chain of being divides at the extremity; in the other it is composed of dissimilar links. Many cases of dimorphism under this second form have been described under the name of alternation of generations.

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* Indeed all animals in which the sexes are distinct are truly dimorphic.

The term, however, has met with much opposition, and is clearly inapplicable to the differences exhibited by insects in different periods of their life. Strictly speaking, the phenomena are very frequently not alternate, and, in the opinion of many eminent naturalists, they are not cases of generation at all*.

In order, then, to have some name for these remarkable phenomena, and to distinguish them from those cases in which the *mature* animal or plant is represented by two or more different forms, I think it would be convenient to retain for these latter exclusively the terms dimorphism and polymorphism; and those cases in which animals or plants pass through a succession of different forms might be distinguished by the name of dieidism or polyeidism.

The conclusions, then, which I think we may draw from the preceding and other considerations, are:—

1st. That the occurrence of metamorphoses arises from the immaturity of the contion in which some animals quit the egg.

2nd. That the form of the larva in insects, whenever it departs from the original vermiform type, depends in great measure on the conditions in which it lives. The external forces acting upon it are different from those which affect the mature form; and thus changes are produced in the young which have reference to its immediate wants, rather than to its final form.

3rd. That metamorphoses may therefore be divided into two kinds, developmental and adaptational.

4th. The apparent abruptness of the changes which insects undergo arises in great measure from the hardness of their skin, which permits no gradual alteration of form, and which is itself necessary in order to afford sufficient support to the muscles.

5th. The immobility of the pupa or chrysalis depends on the rapidity of the changes going on in it.

6th. Although the majority of insects go through three well-marked stages after leaving the egg, still a large number arrive at maturity through a somewhat indefinite number of slight changes.

7th. When the external organs arrive at this final form before the organs of reproduction are matured, these changes are known as metamorphoses; when, on the contrary, the organs of reproduction are functionally perfect before the external organs, or when the creature has the power of budding, then the phenomenon is known as alternation of generations.

Insects present every gradation, from simple growth to alternation of generations.

8th. Thus, then, it appears probable that this remarkable phenomenon may have arisen from the simple circumstance that certain animals leave the egg at a very early stage of development, and that the external forces acting on the young are different from those which affect the mature form.

9th. The dimorphism thus produced differs in many important respects from the dimorphism of the mature form which we find, for instance, in ants and bees; it would therefore be convenient to distinguish it by a different name; and I have ventured to suggest the terms Dieidism and Polyeidism.

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* "There is no such thing as a true case of 'alternation of generations' in the animal kingdom; there is only an alternation of true generation with the totally distinct process of gemmation or fission."—*Huxley on Animal Individuality*, Ann. & Mag. of Nat. Hist., June 1852.

The same considerations explain the remarkable fact that in alternation of generations the reproduction is agamic in the one form. This is because impregnation requires the perfection both of external and internal organs; and if the phenomenon arises, as has just been suggested, from the fact that the internal organs arrive at maturity before the external ones, impregnation cannot take place, and reproduction will only result in those species which have the power of agamic multiplication.

Time of moulting.	State.	No. of days.	Time of moulting.	State.	No. of days.
Specimen No. 1.			Specimen No. 2.		
Captured Sept. 8	4th		Captured Aug. 17	9th	
Moulted „ 9	5th		Moulted „ 21	10th	
„ „ 11	6th	2	„ „ 23	11th	2
„ „ 15	7th	4	„ „ 30	12th	7
„ „ 18	8th	3	„ Sept. 6	13th	7
„ „ 21	9th	3	„ „ 10	14th	4
„ „ 24	10th	3	„ „ 15	15th	5
„ „ 27	11th	3	„ „ 21	..	6
„ „ 30	12th	3	„ „ 27	16th	6
During October I was for some days away from home.			„ Oct. 4	..	7
„ Oct. 24	13th		„ „ 13	..	9
„ Nov. 2	„	9	„ Nov. 6	17th	24
„ „ 17	14th	15	„ „ 25	„	19
„ Dec. 8	„	21	„ Dec. 11	„	16
„ „ 24	15th	16	„ „ 30	..	19
„ Jan. 7	„	14	„ Jan. 18	Rudiments of wings covering half the 1st abdominal segment.	19
„ „ 23	„	16	„ Feb. 4	„	17
„ Feb. 8	16th	16	„ „ 22	„	18
„ „ 18	„	10	„ March 6	„	12
„ March 1	17th	11	„ „ 24	19th	18
„ „ 10	„	9	„ April 1	Rudiments of wings covering $\frac{2}{3}$ of the 2nd abdominal segment.	8
„ „ 20	„	10	„ „ 10	Rudiments of wings covering $\frac{3}{4}$ of the 3rd abdominal segment.	9
„ „ 30	Rudiments of wings covering much of the 1st abdominal segment.	10			
„ April 10	„	11			
„ „ 29 ?	Rudiments of wings covering much of the 3rd abdominal segment.	?			
„ May 14	Proimago.				

DESCRIPTION OF THE PLATES.

Plate LVIII.

Fig. 1. Basal part of one of the caudal processes, showing the mode of reproduction, × 60.

Fig. 2. Basal portion of the antenna in the 20th state, showing, within, that of the proimago, × 60.

Fig. 3. Portion of the above, × 250.

Fig. 4. Upper lip of full-grown larva, × 60.

Fig. 5. Mandible, × 60.

Fig. 6. Processes of ditto, × 250.

Fig. 7. Maxilla, × 60.

Fig. 8. Labium, × 60.

Fig. 9. Tongue?, × 60.

Fig. 10. Egg-tube, × 250.

Fig. 11. Portion of abdominal process, × 250.

Plate LIX.

Fig. 12. Fore leg of proimago, × 30.

Fig. 13. Margin of wing of ditto, × 250.

Fig. 14. Posterior segment of the abdomen in the male, seen from below, × 60.

Fig. 15. Head of imago, × 30.

Fig. 16. Fore leg of imago, × 30.

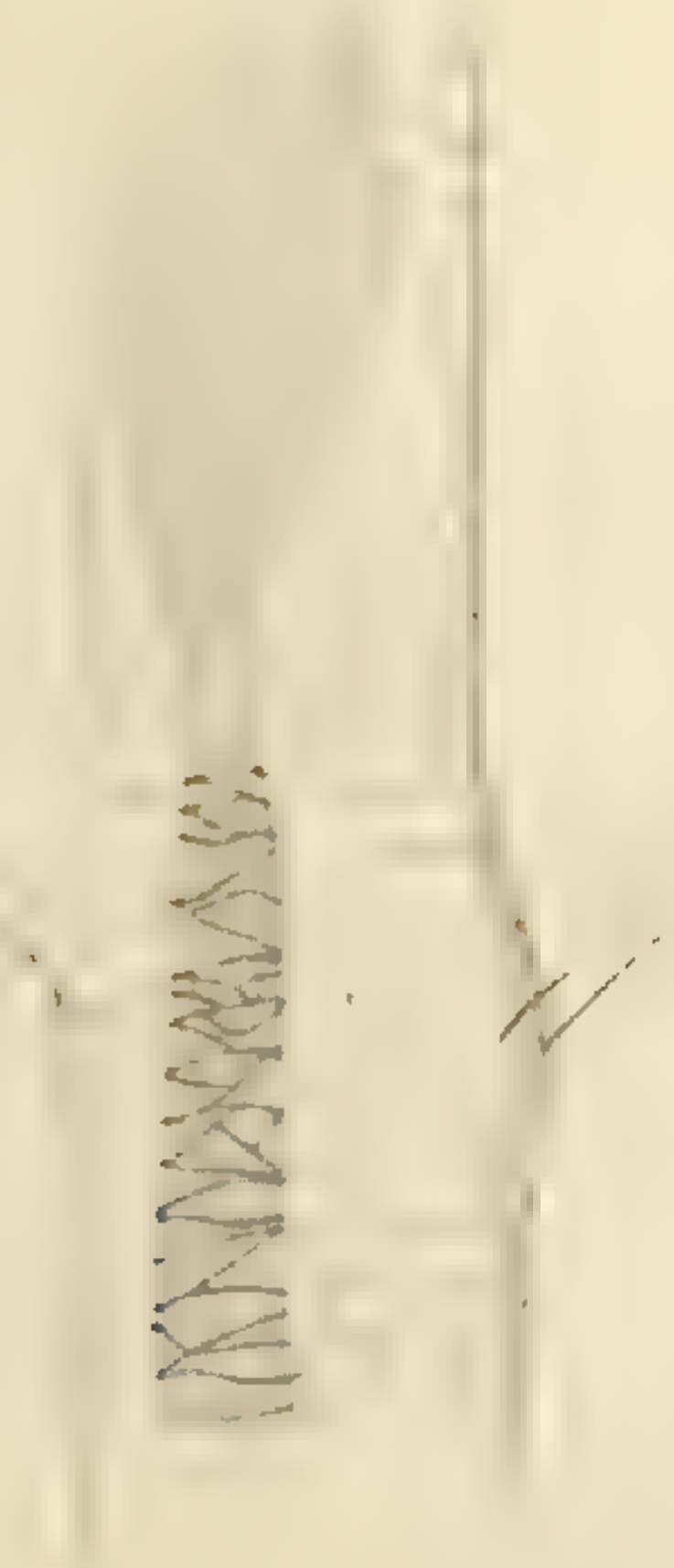
Fig. 17. Hind leg of ditto, × 30.

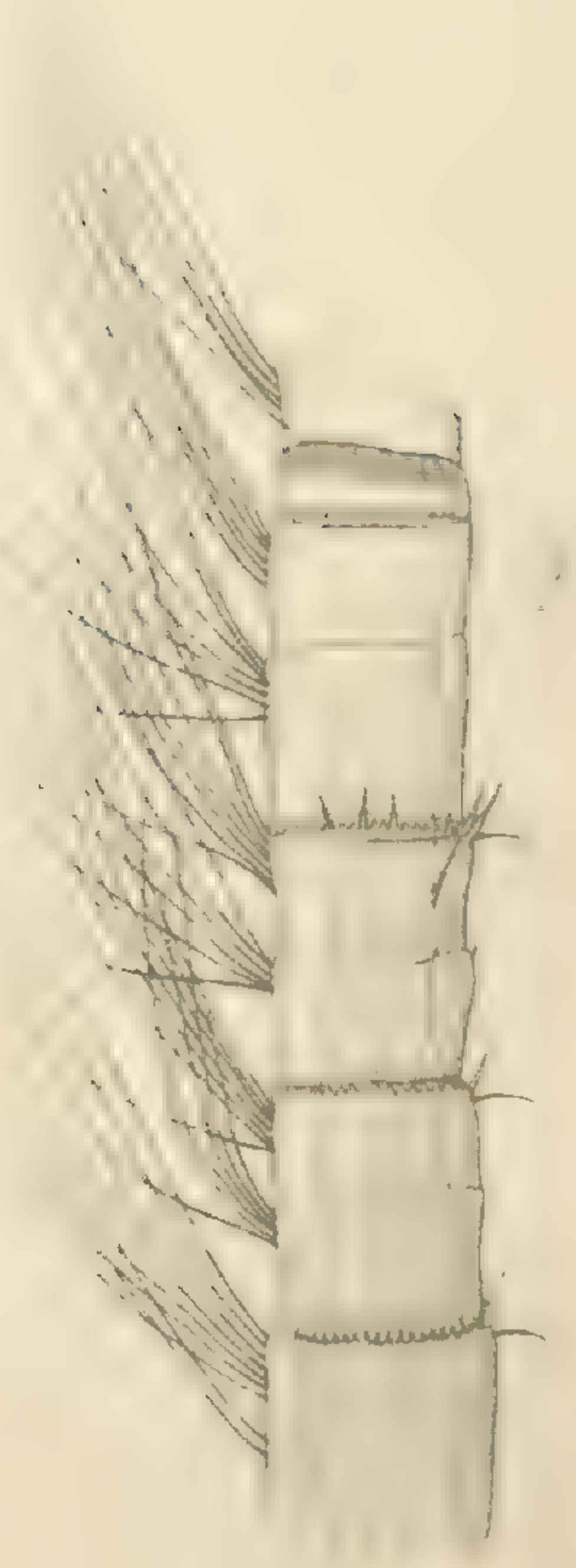
Fig. 18. Margin of wing of imago, × 250.

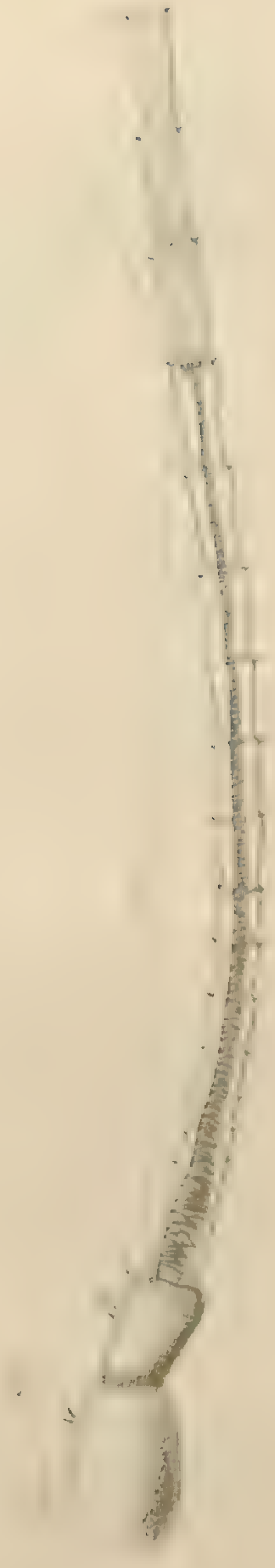
Fig. 19. *Chloë* (Diptera) : proimago, female, after Pictet, about half the natural size.

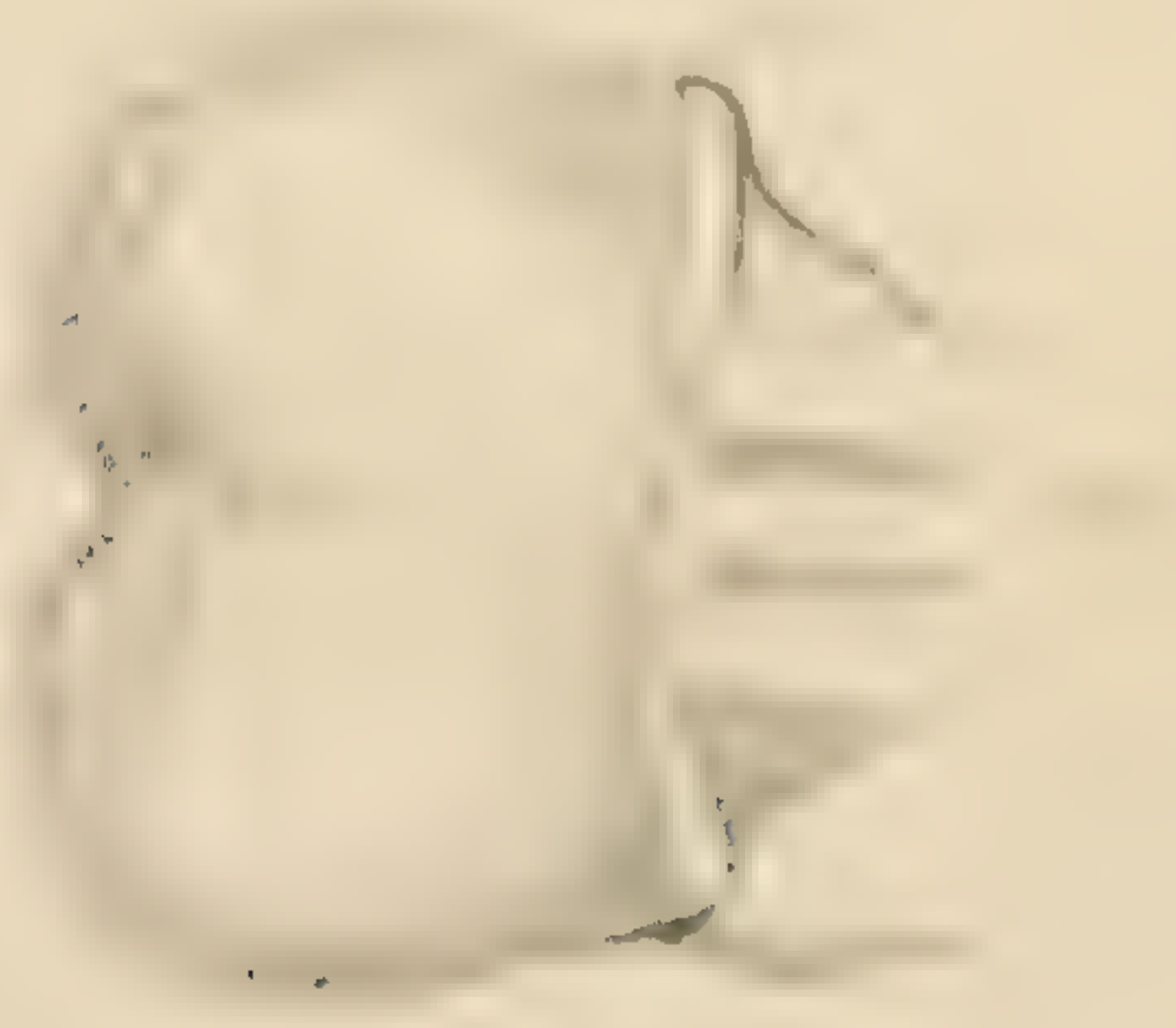
Fig. 20. *Chloë* (Diptera) : imago, female.

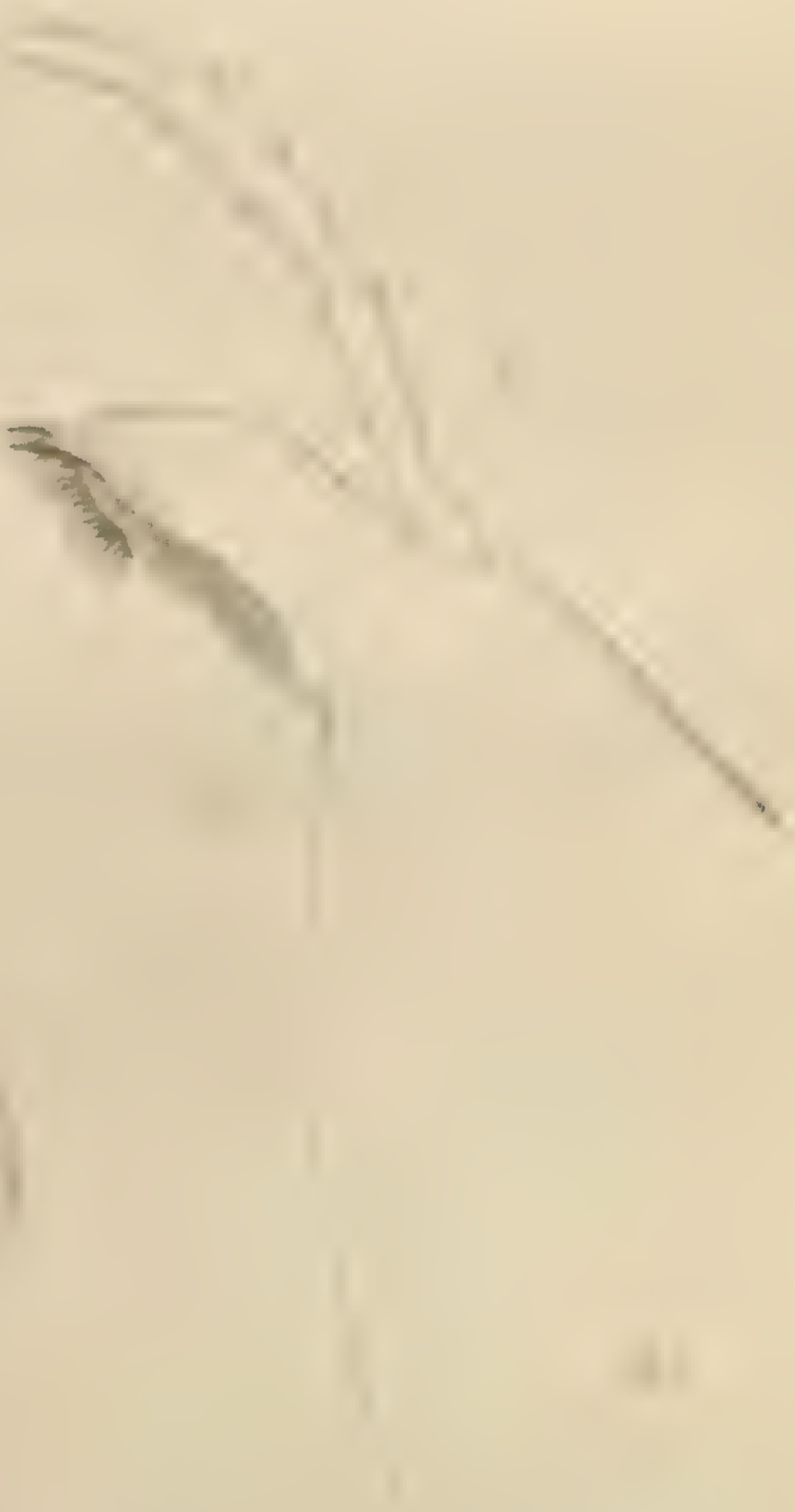
Fig. 21. *Chloë* (Diptera) : imago, male.

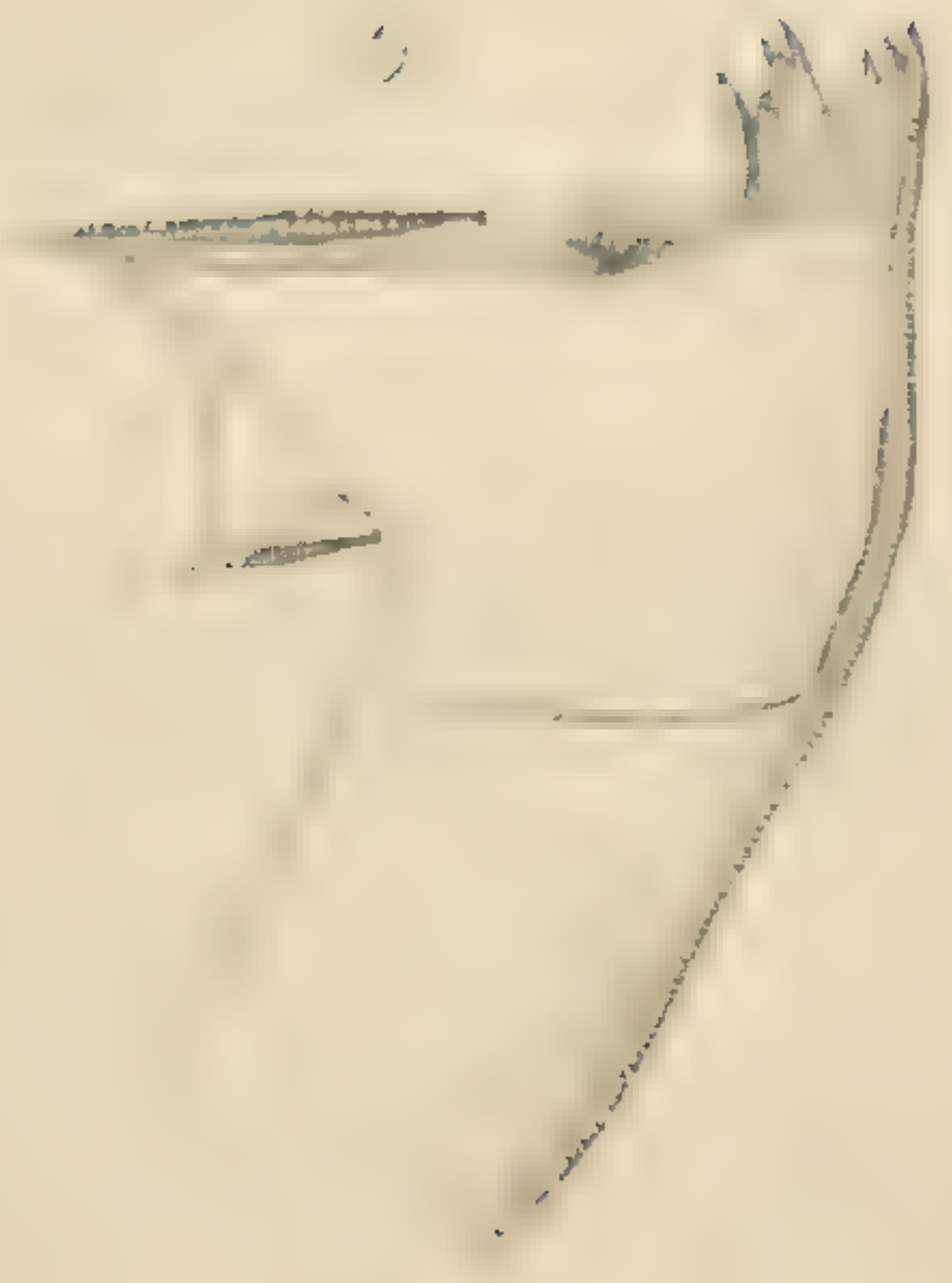


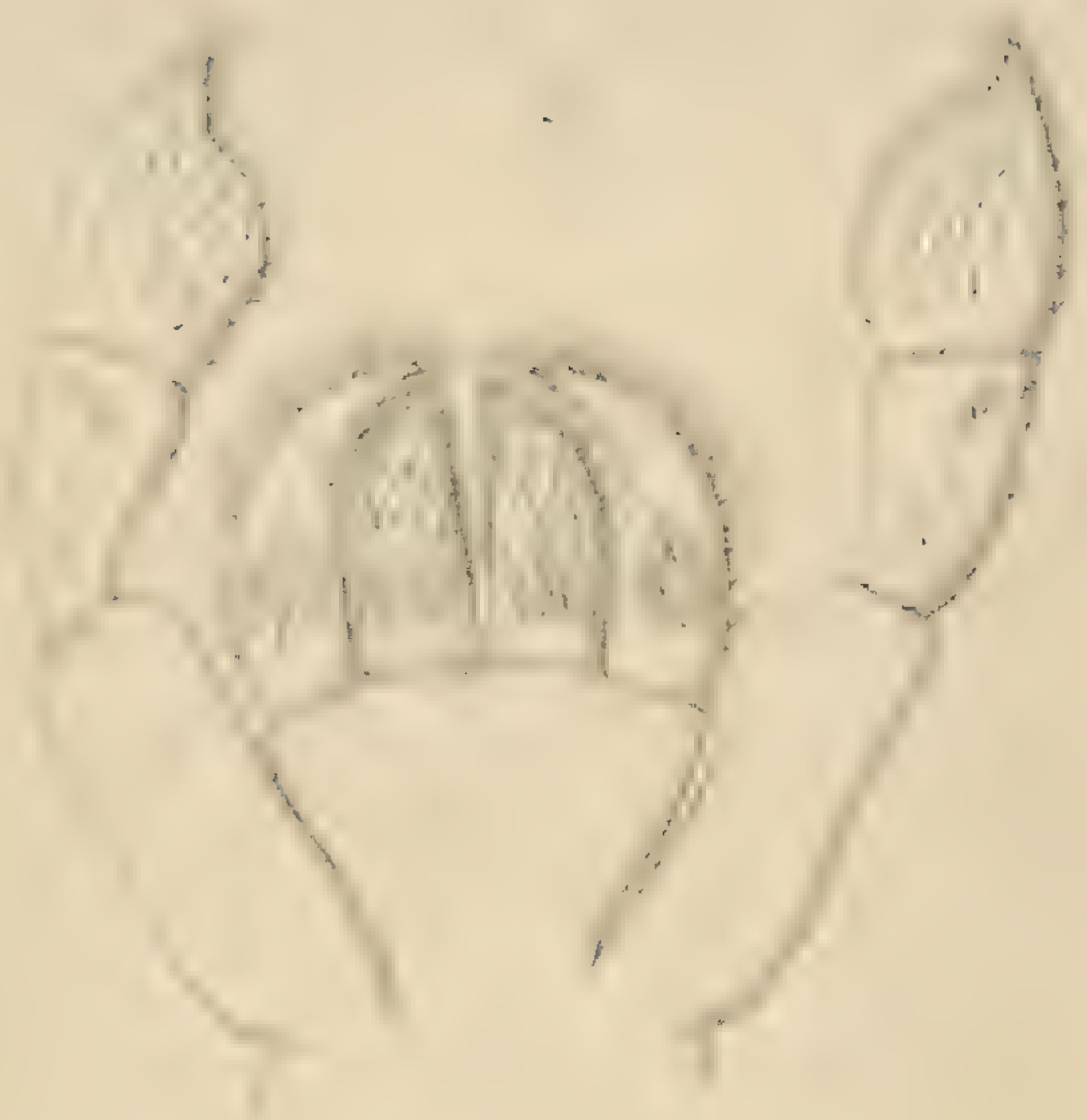


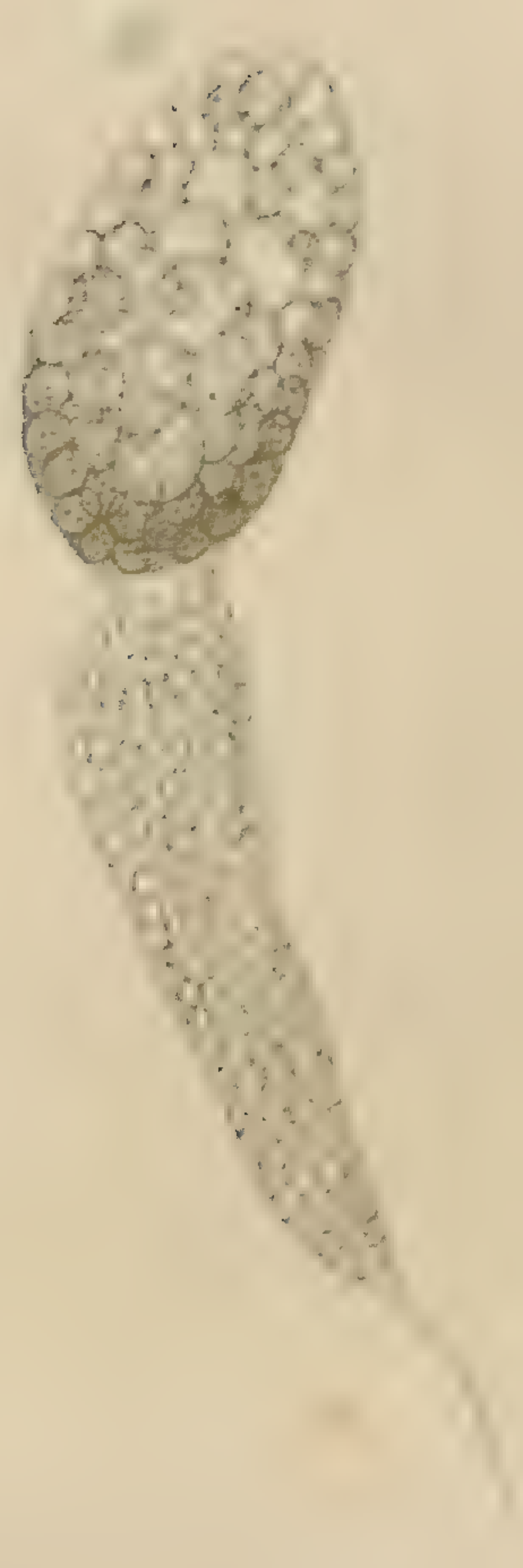


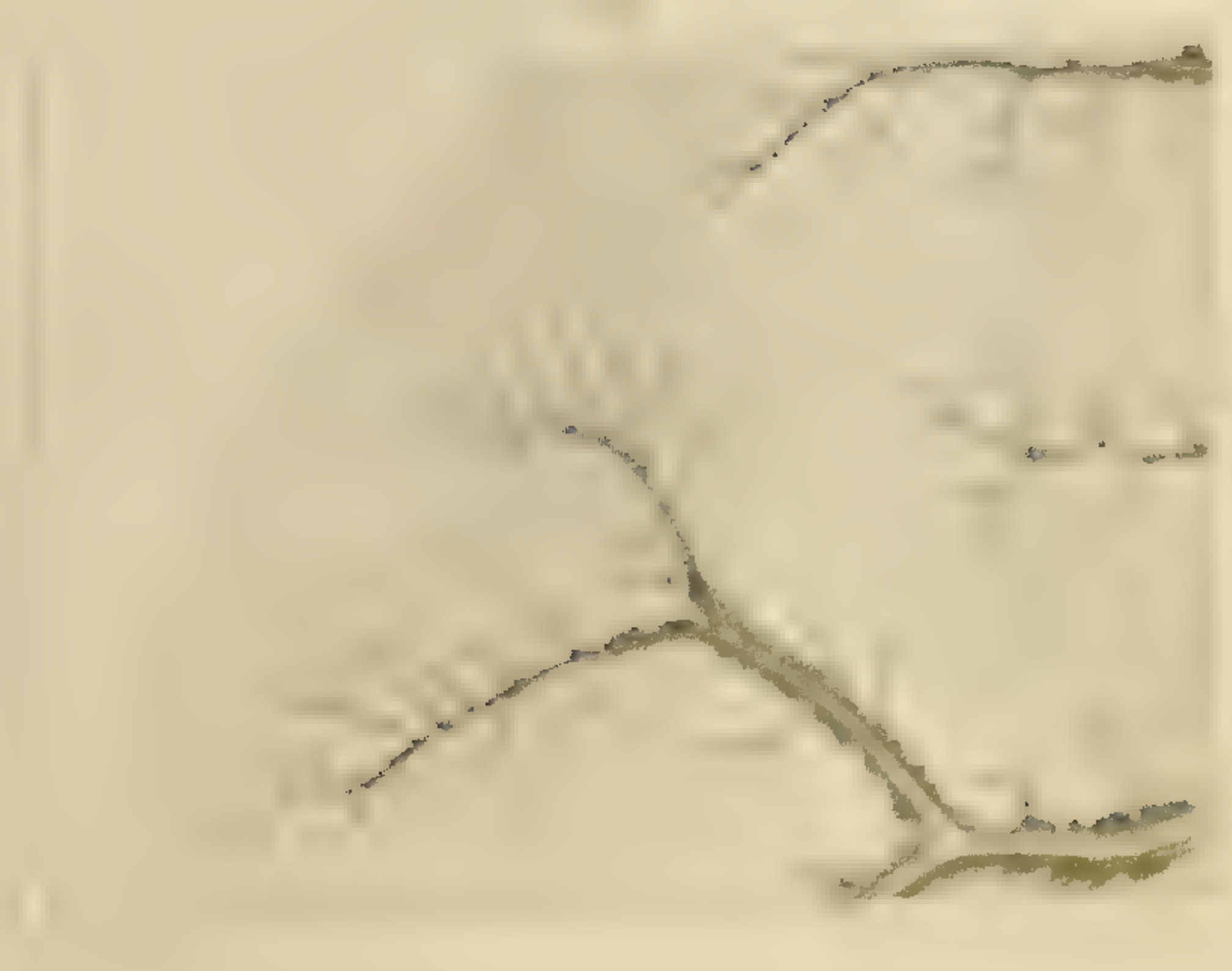


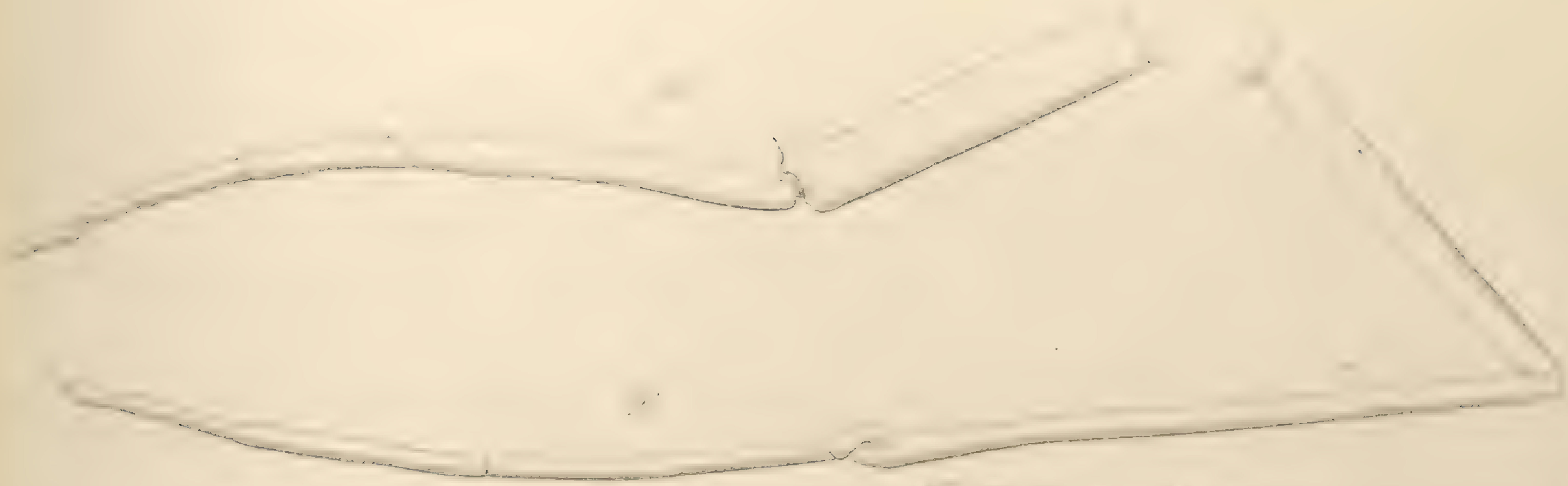


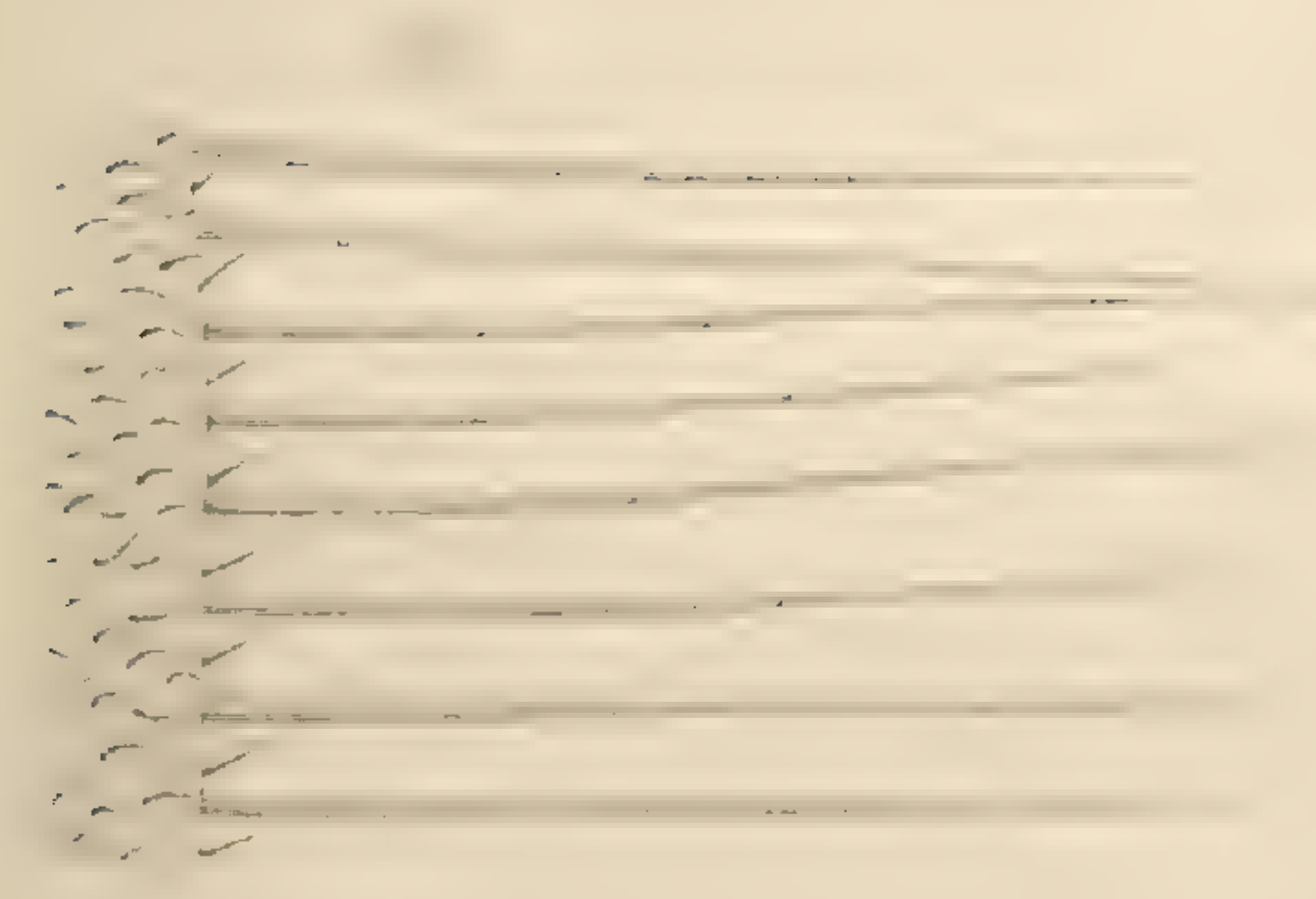


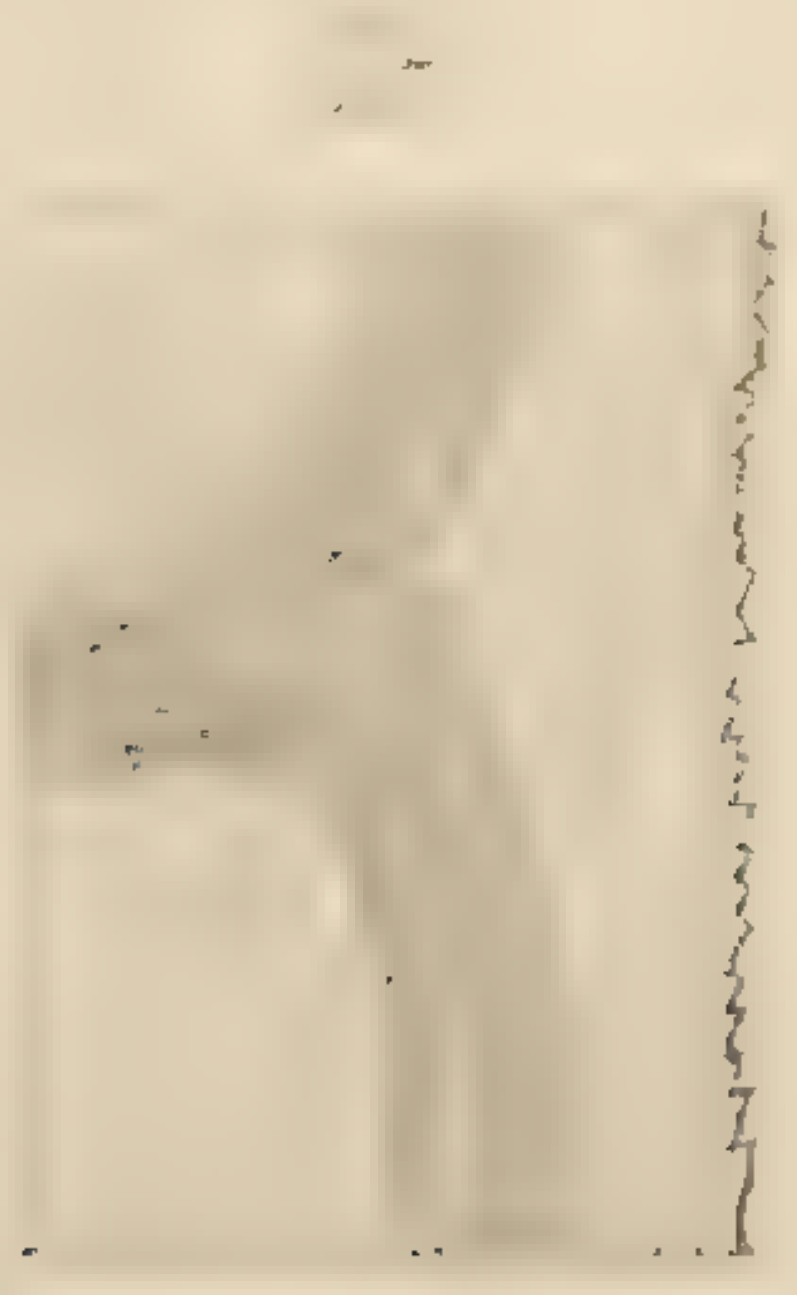


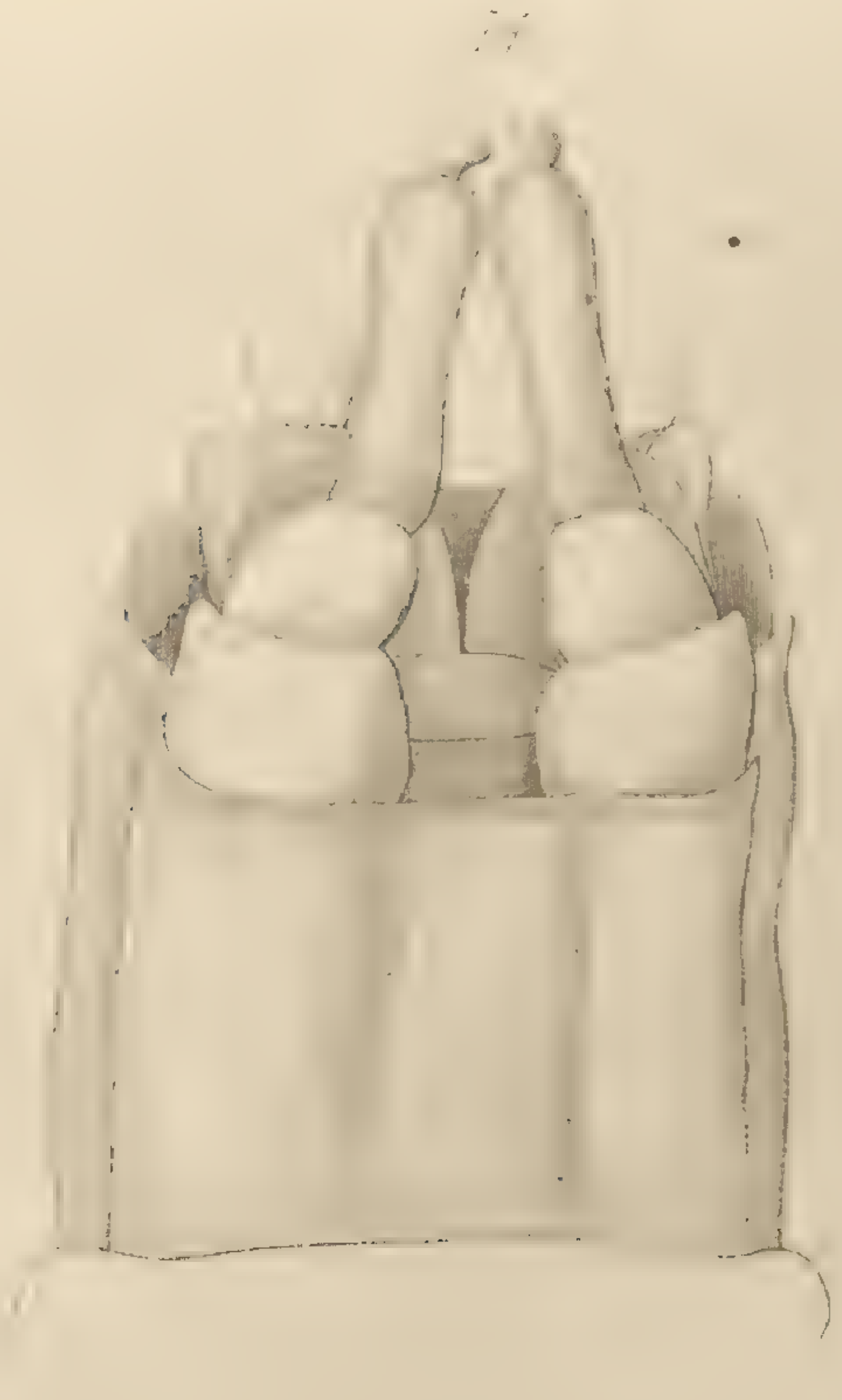


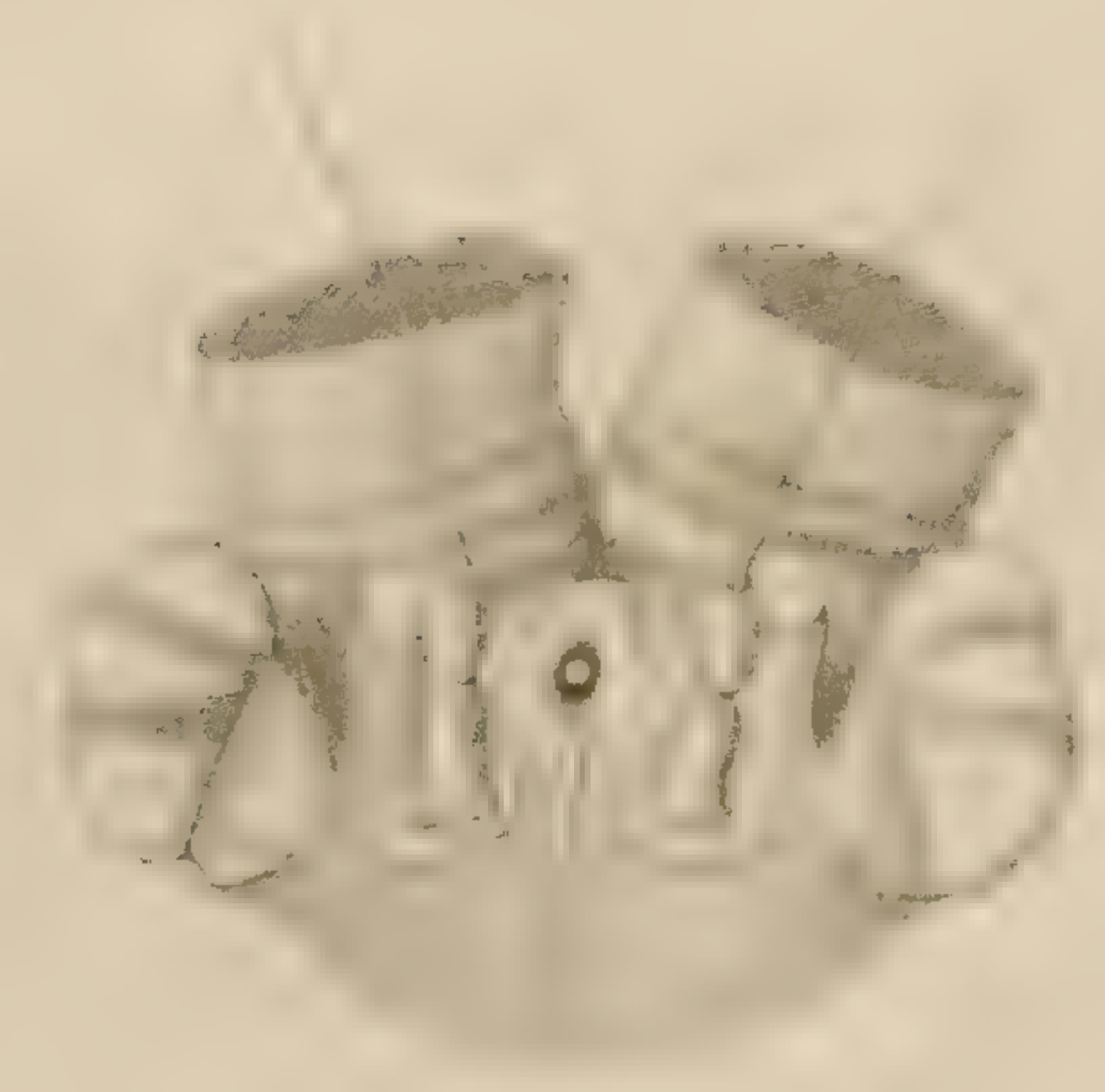


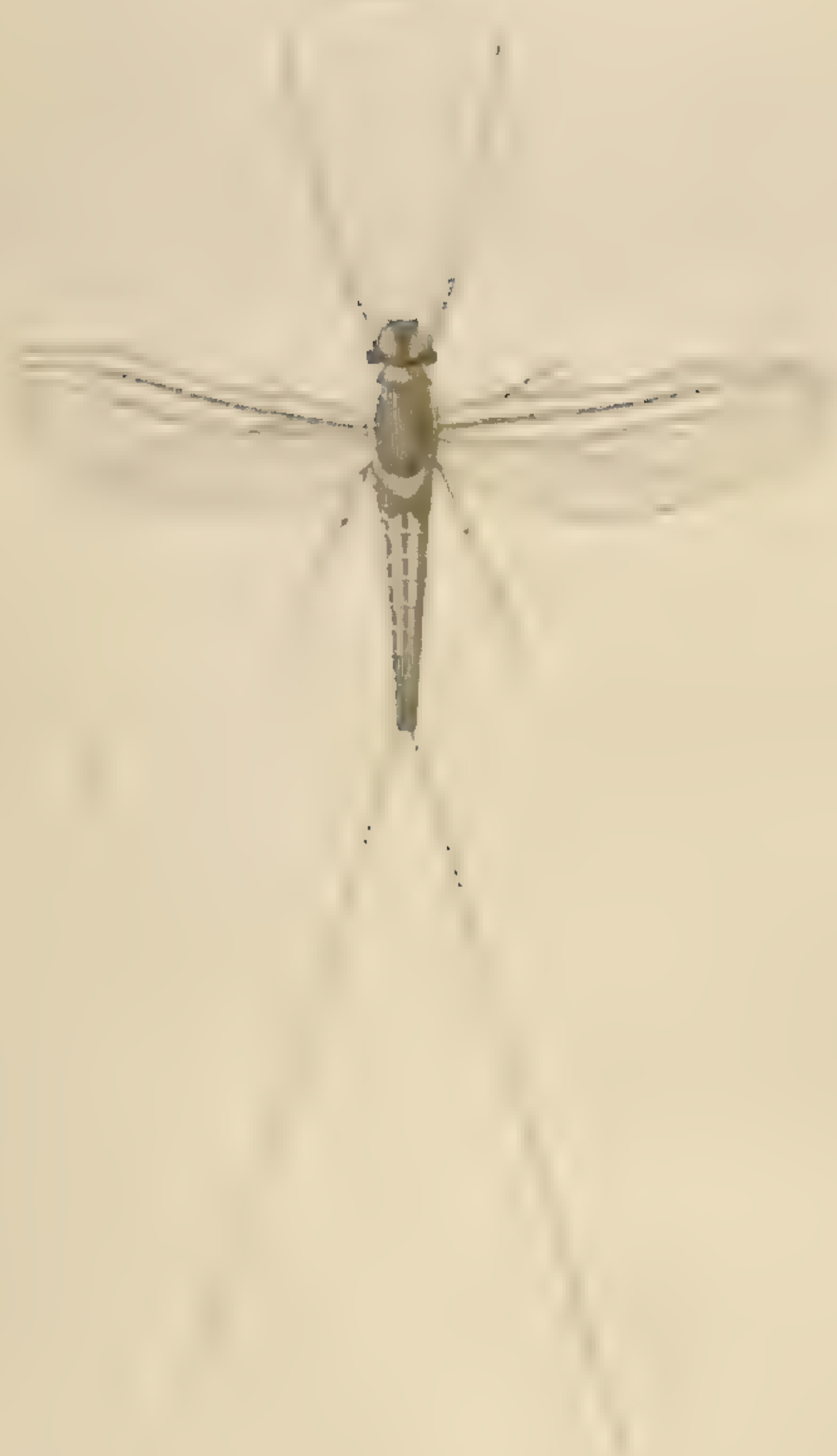


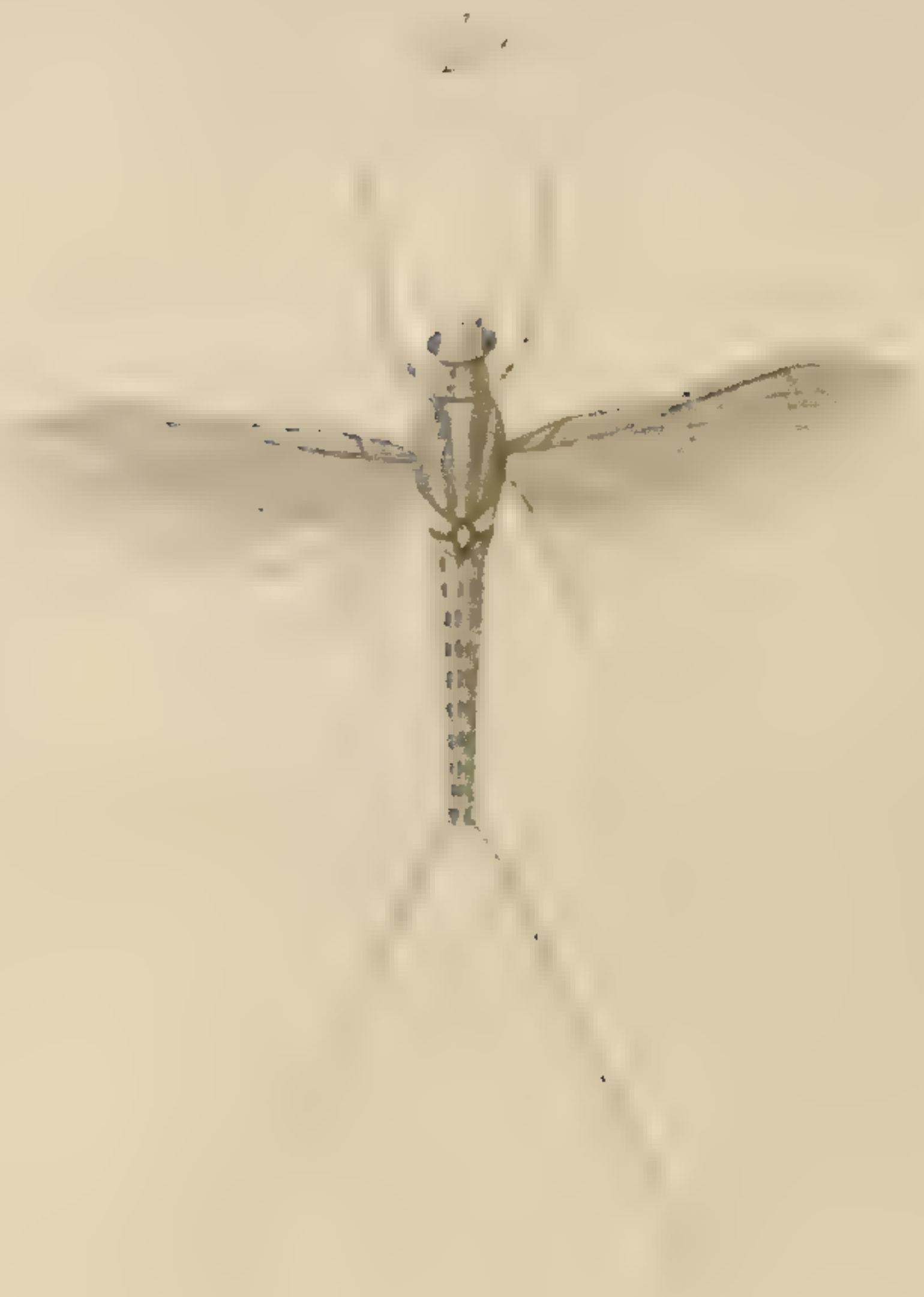


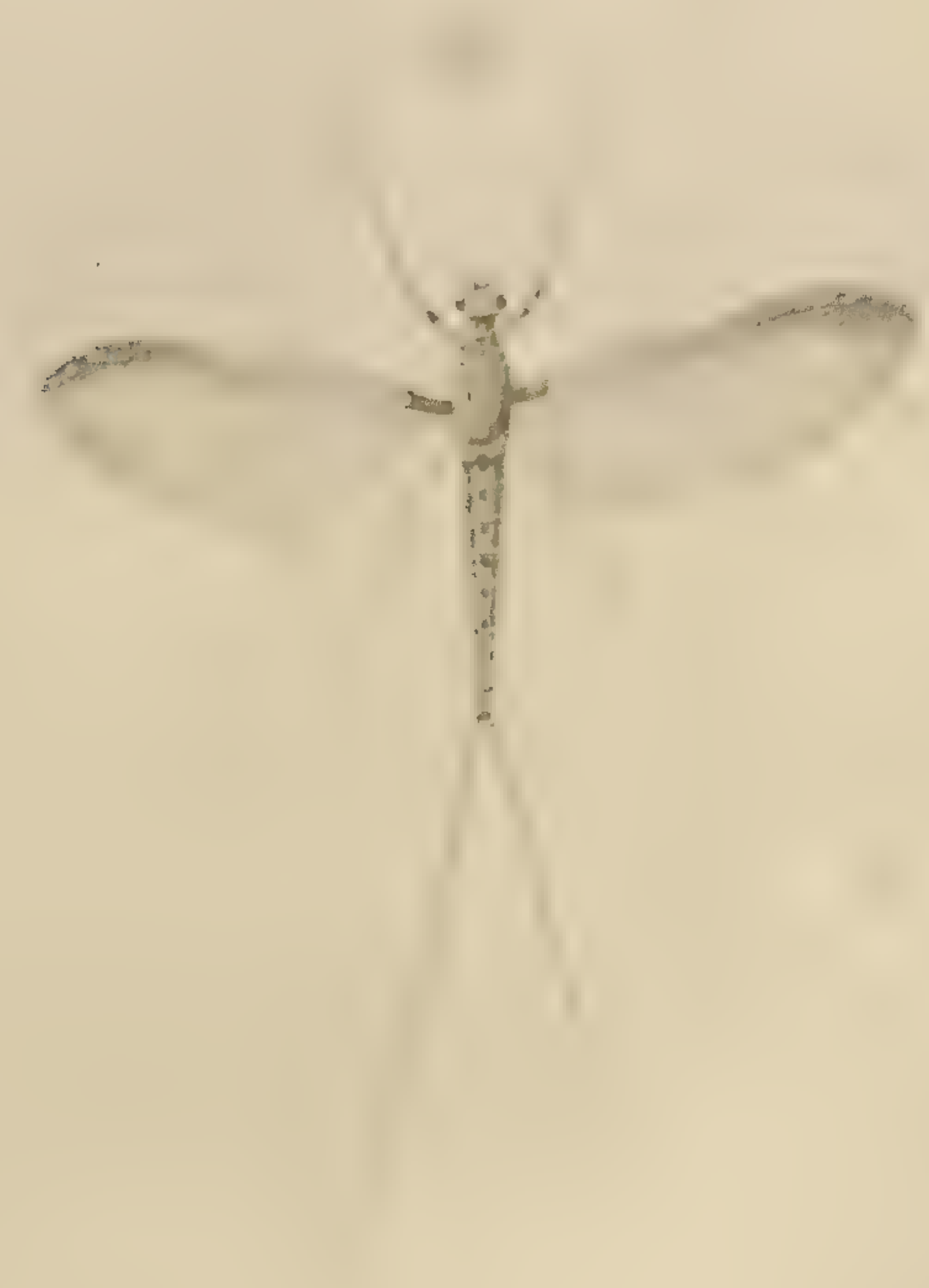












XX. *Observations on New-Zealand Lichens.* By W. LAUDER LINDSAY, *M.D., F.R.S. Edinb., &c.*

(Plates LX.–LXIII.)

Read June 7th, 1866.

Introduction.

THE subjects of the following "Observations" are mainly a collection of lichens I made in the province of Otago, New Zealand, in 1861[*],—and certain other New-Zealand lichens in my herbarium, mostly given me by Dr. Hooker of Kew, and collected by him in the course of Sir James Ross's antarctic expedition in 1839–43—or sent me by Dr. Müller of Melbourne, partly from the Chatham Islands (collected by Mr. Travers, Jun., of Christchurch, Canterbury, N. Z.), partly from the Wellington district. I have included or incorporated my Notes on the New-Zealand lichens contained (in 1858) in the Hookerian herbarium, Kew[†], most of which appear to have been collected by the Rev. Wm. Colenso, M.A., F.L.S., now of Napier, N. Z. This suite of specimens includes, Professor Churchill Babington informs me, all the lichens enumerated by him in Dr. Hooker's 'Flora Novæ Zealandiæ' in 1855. In 1858 I also examined *all* the lichens in the herbaria of (1) the University of Edinburgh (which includes the Menziesian and Grevillean collections), (2) the British Museum, and (3) Linnæus, in the Linnean Society's library,—but without fruit as to New-Zealand species. The first-mentioned herbarium contained only a few unimportant forms collected by Mossman in 1850; the others none.

The following "Observations" themselves refer chiefly to the minute or microscopic anatomy of the reproductive organs of the species examined, especially to the characters of the spores and spermatia. They relate secondarily to those naked-eye or external characters which mainly bear on the classification of species.

I have adopted here Nylander's nomenclature and classification, as being both the most recent and the most philosophical with which I am acquainted. No living authority has had the same extensive opportunities of examining, with the microscope, lichens from every quarter of the globe; none, therefore, can be more familiar with their variations under differences of climate and habitat, none so well qualified to define genera and species with sufficient comprehensiveness and exactitude, or to simplify classification to its greatest practicable extent. Accordingly, contrasting his classifications with those of the modern continental school of lichenologists, as this is represented in Germany by Körber and Krempelhuber, in Italy by Massalongo, De Notaris, Anzi, Garovaglio and Gibelli, in Switzerland by Stizenberger and Heppe, in Scandinavia by Fries and Norman, and in this country by Mudd and Leighton, it appears to me greatly more natural and simple. With all diffidence, however, I cannot profess to concur in *all* Nylander's tribal, generic, or specific divisions, or in his grounds therefor; while I feel myself compelled, after a careful study of the subject for twelve or fifteen years, to go further than he does in the direction of simplicity and naturalness—in the reduction of the present number of book species and varieties, and in the consequent diminution of names, giving attention less to minute, trivial, or inconstant anatomical differences than to general external resemblances. The principles and practice of the classification of Lichens is, however, a subject, as it appears to me, of such interest and importance to the Cryptogamic botanist, that I propose, at some future time, devoting a special essay thereto.

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[*] Enumerated in a "List of Lichens collected in Otago, N. Z."—Trans. Botan. Soc. Edinb. vol. viii. p. 349.

[†] For ample facilities in examining which I am indebted to the kindness of the late Sir W. J. Hooker and of Dr. Hooker, the past and present distinguished Directors of the Royal Botanic Garden of Kew.

I. *The New-Zealand* STICTÆ. (Plate LX.)

New Zealand is, *par excellence*, the country of the *Stictæ*. Not only do they there occur in the greatest absolute as well as relative numbers, but there they attain their maximum development, size, and beauty. In Britain, according to the latest authority, Mudd, there are thirteen species of the genera *Sticta*, *Stictina*, and *Ricasolia* (into which the old genus *Sticta* has of late years been subdivided by continental lichenologists). In New Zealand, on the other hand, according to Babington, there are twenty-seven, or more than twice as many. They are also numerous in relation to the *Parmeliæ*, whose place they to a great extent occupy in New Zealand, especially in the forests. While in Britain the proportion of the *Stictæ* to the *Parmeliæ* is as 100 to 366, and throughout the world generally as 100 to 154, in New Zealand it is as 100 to 84. This preponderance of the *Stictæ*, their frequently great size and beauty of colouring, and the profusion of individuals give a sometimes peculiar character to the foliaceous Lichen-flora of New Zealand.

The *Stictæ* are one of the most variable and puzzling groups of the higher or foliaceous Lichens. As in many other families and genera, extreme forms are sufficiently distinct; but if the collector assiduously devotes himself to the study of the same species under different conditions of growth in different countries, or even in different parts of the same country, his patience and perseverance will be rewarded by the discovery of every intermediate gradation between forms apparently otherwise the most divergent. The discovery of such gradation-forms will, on the one hand, occasionally set at defiance all his endeavours to define or limit species, and, on the other, in certain cases will enable him to group two or more supposed autonomous species in one.

There are, on the one hand, certain striking uniformities of character throughout the genera *Sticta*, *Stictina*, and *Ricasolia*, and, on the other, certain general directions or forms of variation which it is convenient to consider in a group in reference especially to definition or limitation of species and genera.

1. *Spermogones.*—The uniformity throughout the three genera just mentioned (which I regard, however, as mere subdivisions or groups of the genus *Sticta*) is, perhaps, most striking in regard to the contents or constituents of the spermogones—the spermatia and sterigmata. The former are rod-shaped, and the latter articulated, irregular, and ramose, composed of short thick-walled subcubical cellules (figs. 4, 8, 13, 18). Those of *S. pul-*

monacea may be regarded as the type of the whole. The body of the spermogone is generally the same throughout the *Sticta*; but the site and aspect of the ostiole, by which its presence is recognized on the surface of the thallus, differ somewhat, though not in essentials. Sometimes the spermogones are scattered irregularly over the thallus, or they are peripheral, or they are confined to the thalline rugæ; they may be papillate, especially in *Ricasolia*, or the ostiole may be punctiform and even depressed *.

2. *Apothecia.*—There is also great uniformity as regards the characters of the contents or constituents of the apothecia. The hymenium, in section (figs. 4, 14), usually distinctly exhibits its constituents—thecæ, paraphyses, epithecial membrane (when present), and hypothecial cellular tissue, with associated oil-globules (if present); and such a section is generally as readily made as it is easily seen, and is most instructive as illustrative of the structure of the apothecia of the higher Lichens. The hymenial lichenine frequently gives a reaction with iodine resembling that of the thecæ (to be immediately described). The paraphyses are usually subdiscrete, delicate, filiform, distinct, united more or less closely at their apices or heads, which are generally tuberculiform or clavate, and of various shades of brown or brownish yellow. The thecæ are distinct, longish, obovate superiorly, with sometimes a subelongated pedicle, 8-spored, giving with iodine a beautiful blue colour, which, though sometimes pale, generally varies little in shade. The spores are usually ellipsoid or fusiform, and with broadly rounded or narrowly tapering extremities, generally 1–3-septate, but sometimes exceptionally simple or 4–7-septate †. Within the thecæ, and in maturity, bilocularity is the normal or general condition (figs. 4, 9 & 14). In the young state the spore-contents have not yet divided, and the spore appears simple; in the old state subdivision of each locule has occurred, and 4-locularity is the result ‡. This subdivision may go further with age, prior to the complete breaking up of the loculi into a granular mass preceding germination, and produce six or seven loculi (fig. 16 *b*, *c*); but this is rare. There is considerable variation both as regards form, size, number of loculi, and colour, sometimes even in the same species, under different conditions of growth. The typical colour (where colour exists) is brown; and the tendency in most cases seems to be to become brown in age, if not earlier. In the young state, spores which are brown in maturity are frequently some shade of olive. In the young state, also, they are sometimes, though rarely, pale yellow or colourless; and this condition may occur throughout the life of the spore, though more generally it gradually assumes some shade of olive or brown with age. In exceptional cases the spore is polari-bilocular or physcioid (figs. 1, 3, 6, 19, 21), resembling that of some of the common *Physciæ* (e. g. *P. parietina*, L.); that is to say, the two loculi, instead of occupying the

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* Memoir on Spermogones, pp. 191 & 201, plate x.

† *Sticta cinereo-glauca*, Tayl. [Linds. Spermog. 193; Nyl. Syn. 358; Bab. L. N. Z. p. 19, plate cxxvii. *c*], is one of the few species which possess spores of an exceptional character; they are here 5–7-septate according to Babington's figure, 7-septate according to Nyl.

‡ The very reverse is described by Norman, whose observations on this subject are utterly opposed to mine. “Conatus præmissus Redactionis novæ Generum nonnullorum Lichenum in organis fructificationis vel sporis fundatæ,” with two plates, by J. M. Norman, ‘Nyt Magazin for Naturvidenskaberne,’ Christiania, 1853, vol. vii. p. 226.]

whole spore-cavity, separated only by a narrow linear septum or interspace, are about half the usual size, or about the size of the terminal loculi where the spore is quadrilocular, are seated at the opposite poles or extremities of the spore, and are connected generally by a narrow linear tubule, which runs up the long axis of the spore*. The apothecia do not vary much in external characters. The disk is usually flat, and of various shades of red or brown, girt by a thickish distinct exciple of the colour of the thallus. Both disk and exciple, however, are subject to various forms of degeneration. The former may become urceolate from shrinkage, or biatorine and convex from turgescence, or it may become partly or wholly eroded, or it may fall away entirely, leaving only an irregular saucer-shaped scar, which is whitish or yellowish, generally according to the colour of the medullary tissue of the thallus; or it may become the site of the black parasitic *Celidium Stictarum*, Tul. (figs. 26, 27), which quite alters its appearance, rendering it irregularly tuberculate as well as black. Misunderstanding the nature of this deformity, Fée arranged the species affected by this parasite in separate genera, *Delisea* and *Plectocarpon* [Nyl. Syn. 352]; while other authors have described them as *varieties*†. The exciple, or apothecial margin, sometimes becomes fringed with minute squamulose or granulose growths, similar to those which occur also on the thallus; or it is pilose or tomentose, like the thallus; or it rises above or sinks below the disk, or becomes thickened or attenuated, or it disappears.

3. *Thallus.*—Its colour (cortical layer) is generally some shade of brown, yellow, or crimson, or some combination of these colours. Under water, many herbarium specimens of a buff or brown tint become brilliantly green, or assume various duller shades of that colour on the upper surface of the thallus, the under surface being generally unchanged, or being only deepened in its usual brownish tint. Those with a yellow or red thallus also acquire various shades of green. Species with a greyish-brown thallus become deep slate-coloured (bluish black); and generally at the same time they exhale the peculiar strong odour so characteristic of our *Stictina fuliginosa* and *S. sylvatica*. It would appear, indeed, that the colour of the thallus bears a close relation to the degree of moisture and exposure to light. The medullary tissue in a large section of the *Stictæ* is whitish, in another it is of various shades of gamboge-yellow. It is generally prominently exhibited, from the contrast of its colour to that of the cortical layer, wherever there are fissures or erosions of the latter, or cephalodia, cyphellæ, pseudo-cyphellæ, isidia, or soredia, all of which are more or less abundant on the thallus of the *Stictæ*. The colour, however, both of cortical and medullary layers varies occasionally even in the same species, so that, as a diagnostic character, colour *per se* cannot be altogether relied on.

* Exceptionally (*e.g.* in *Sticta scrobiculata*, Ach., from Inverary, Scotland) I have found the epispore coloured blue, like the thecæ, under iodine—a circumstance which also occurs in the spores of *Parmelia megaleia*, Nyl., and of a few other lichens.

† The *Celidium* affects also the thallus, either upper or under surface, generally the former, seated on and probably producing cephalodiiform tubercles, that frequently resemble those apothecia which are rendered difform and degenerate by the growth of the same common parasite [Nyl. Syn. 352]. It occurs also on cephalodia proper, *e.g.* those of *Ricasolia corrosa* [Nyl. Syn. 372]. The parasite appears thus to affect alike species of the genera *Sticta*, *Stictina*, and *Ricasolia* [Linds. Observ. on new Lichens and Fungi from Otago, N. Z., p. 452, plate xxx. figs. 47–52].

Systematists have laid much stress on the presence or absence of cyphellæ, or pseudocyphellæ, as a means of distinguishing *Sticta*, *Stictina*, and *Ricasolia*. Their presence and absence, however, are most capricious; and even in the true genus *Sticta*, as defined by Nylander, species are to be found which are acyphellate, cyphellate, or pseudocyphellate. There is considerable variation in regard to the smoothness or roughness of the surface of the thallus, and the nature and extent of division of the margins of its lobes. The same species which has at one time a smooth thallus, exhibits it in other circumstances subfossulate, or roughened by granulations, or furfuraceous with a minute squamulose growth, as to the upper surface. The under surface may be in the same species smoothish, or granulose, or fibrillose, to various extents. The edge of the divisions of the thallus is sometimes still further and very minutely subdivided into a mass of squamusculæ, which may assume the form of columnar isidiiform growths of subcoralloid aspect. Sometimes, apparently especially in sterile conditions of the thallus, it is covered with dense masses of these squamuscles or granulations. Some species are never found save in a sterile state; and in these cases it is at least doubtful, I think, whether they are all autonomous species. In many species the thallus is extremely liable to decortication or erosion of the cortical layer, whereby the differently coloured medullary tissue is prominently exposed. Sometimes this erosion is general, involving the whole thallus; more generally it affects it only in irregular patches.

It appears to me, on the one hand, that there is no sufficient ground for the generic separation of *Stictina* and *Ricasolia* from *Sticta* *, and, on the other, that the number of book species of all these three genera admits of material reduction. I allow that the *Stictæ* are naturally divisible into three groups—the central, highest, or typical one represented in this country by *Sticta pulmonacea* and *S. damæcornis*, and in New Zealand by *S. fossulata* and *S. latifrons*. Of the other two, one connects *Sticta* with *Peltigera*, and is represented by such species as *Stictina fuliginosa*; the other connects *Sticta* with *Parmelia*, the representatives whereof are *Ricasolia herbacea* or *R. glomulifera*. I do not, however, think that these groups possess characters admitting of their distinct limitation; the general resemblances are much more weighty than any minute or inconstant differences. In regard to book species, I have found, by watching for them, even in the same locality, transition forms connecting two species so intimately that it is impossible for me to believe them distinct. Thus, in the Pass of Leny, near Callander, I have found *Stictina sylvatica* and *fuliginosa* passing freely into each other so imperceptibly that I am forced to regard both as referable to one specific type. What is called *sylvatica* seems to be the sterile form of the plant, its apothecia being, according to Mudd, unknown. Nor am I satisfied that, among British *Stictæ*, *S. limbata*, *S. elegans*, *S. intricata*, and *S. ciliata* of Mudd's 'Manual,' or, among New-Zealand species, that *Stictina dissimilis*, *Sticta subcoriacea*, *S. Urvillei*, *S. granulata*, *S. dissimulata*, *S. fossulata*, *S. physciospora*, and *Ricasolia Montagnei* of Nylander's Lich. N. Z. † are autonomous.

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* Memoir on Spermogones, pp. 191 & 201.

† "Lichenes Novæ Zealandiæ quos ibi legit anno 1861 Dr. Lauder Lindsay," Journ. of Linnean Society, Botany, vol. ix. p. 244.

SYNOPSIS OF SPECIES AND VARIETIES.

Gen. I. *Sticta.*

Sp. 1. *S. fossulata*, Duf.
  1. Var. *Richardii*, Mont.
  2. „ *linearis*, Hook. & Tayl.
2. *S. physciospora*, Nyl.
3. *S. orygmæa*, Ach.
4. *S. Urvillei*, Dél.
  3. Var. *flavicans*, Hook. & Tayl.
  4. „ *Colensoi*, Bab.
5. *S. dissimulata*, Nyl.
  5. Var. *multifida*, Laur.
6. *S. rubella*, Hook. & Tayl.
7. *S. aurata*, Ach.
8. *S. latifrons*, Rich.
9. *S. damæcornis*, Ach.
10. *S. Freycinetii*, Dél.
11. *S. granulata*, Bab.
S. pulmonacea, Ach.
S. Richardii, Mont.*
S. impressa, Tayl.*
S. carpoloma, Dél.*
S. foveolata, Dél.*
S. cellulifera, Tayl.*
S. linearis, Hook. & Tayl.*
S. flavicans, Tayl.*
S. Colensoi, Bab.*
S. glabra, Tayl.*
S. coriacea, Hook. & Tayl.*
S. cinereo-glauca, Tayl.
S. scrobiculata, Ach.
S. laciniata, Ach.

Gen. II. *Stictina.*

Sp. 1. *S. dissimilis*, Nyl.
2. *S. crocata*, Ach.
3. *S. fuliginosa*, Dicks.
4. *S. fragillima*, Bab.
Var. *lutescens*, Kremp.

Gen. III. *Ricasolia.*

Sp. 1. *R. coriacea*, Hook. & Tayl.
2. *R. Montagnei*, Bab.
R. discolor, Dél.
R. corrosa, Ach.
R. herbacea, De N.

IV. *Parasites.*

Abrothallus Smithii, Tul.
  Var. *microspermus*, Tul.
Celidium Pelvetii, Hepp.
C. Stictarum, Tul.

Those marked with an asterisk are Synonyms.

Genus I. STICTA, Ach. pr. p., Nyl. (Plate LX.)

Sp. 1. S. FOSSULATA, Duf. (Figs. 1, 2.) [Linds. Mem. Spermog. p. 197, plate x. figs. 15 & 26; Obs. Otago, L. & F., p. 449, plate xxx. figs. 48, 49, 51, 52.]

1. On the trunks of dead trees, Saddle-hill bush, and on living trees, East Taeri bush, Otago, N. Z.: W. L. L.: in fruit, and spermogoniferous.

Spores (fig. 1) broadly ellipsoid, 1-septate, sometimes polari-bilocular (*a*), the loculi connected by a median canal, olive or brown, ·0009″ long, ·0003″ broad. Thecæ 8-spored, blue with iodine, ·0036″ long, ·00075″ broad. Paraphyses discrete, filiform, united by brown tuberculated heads. Apothecia marginal; in character, those of the British *S. pulmonacea*, Ach. Spermogones also identical with those of *S. pulmonacea* both in site, external aspect, and internal constitution. Thallus most variable in size, form, colour, smoothness, and other characters. Sometimes it covers trees in large masses, 6 to 12 inches and upwards in diameter, just as *S. pulmonacea* does. Occasionally it is so smooth on the upper surface as to approach *S. damæcornis* in this character; or it is deeply fossulate, without distinct intervening rugæ. Between these conditions there is every intermediate gradation, the commonest forms resembling *S. pulmonacea* both as to the characters of the rugæ and fossæ. The segments of the thallus are sometimes very ragged, from irregular submarginal erosions or perforations; at other times their margins are fringed with squamulose growths. The general colour is dirty brown, sometimes lurid; occasionally there is a greenish hue, one which can be produced artificially at any time by steeping herbarium specimens in water. By destruction, in irregular patches, of the cortical layer, the subjacent white medullary tissue is occasionally exposed. The thallus is liable to be infested with a parasitic *Celidium**.

2. Specimen in my herbarium, sent me by Dr. Müller of Melbourne, labelled only "New Zealand," probably from the Wellington district: in fruit and spermogoniferous (fig. 2). Spores brown, 1- to 3-septate; the former in the young, the latter in the old state; more oval-ellipsoid and with more rounded ends than in my Otago specimens; ·0008″ to ·0009″ long, and ·0004″ broad. Thecæ ·0030″ long, ·0006″ broad. Paraphyses agglutinated at their tips, which are sometimes obscured in the older apothecia by a considerable amount of granular brown colouring-matter.

Spermogones are best seen on the rugæ which occur towards the tips of the thalline laciniæ, beyond the region occupied by the apothecia; they are extremely minute, brown, and punctiform, as seen on the thalline surface; but the body is immersed as a solid and comparatively large, hard, whitish kernel, easily enucleated.

A. Var. *Richardii*, Mont. (Fig. 3). *Sticta Richardii*, Bab. L. N. Z. 13. [Linds. Mem. Spermog. 197.]

3. On trees, East Taeri bush, Otago, N. Z.: W. L. L.: in fruit, and spermogoniferous. Spores have the characters of the type, broadly ellipsoid, 1-septate, in young state sometimes polari-bilocular (*a*), with a connecting longitudinal tubule, olive or brown according to age, ·0006″ to ·0009″ long, and ·0003″ to ·00045″ broad. Thecæ ·0024″ to ·0030″ long, and ·0006″ broad. Paraphyses subdiscrete, with very dark-brown tuberculiform heads. Hymenium (including thecæ) gives a beautiful blue with iodine. Apothecia large and sparingly scattered, marginal. Spermogones seated on the thalline rugæ, abundant and very distinct, punctiform, deep brown or blackish. Thallus large and handsome, sometimes 6 to 8 inches across; colour varies from grey or glaucous to buff or lurid, greenish or olive: occasionally it is covered with a slate-coloured or blackish bloom; rugæ and fossæ generally very prominent.

4. Auckland: Dr. Sinclair, in my herbarium: in fruit and spermogoniferous. Spermogones partly old and degenerate, irregularly stellate, deep brown. Cortical layer of thallus frequently eroded, exposing subjacent green gonidia and white medullary tissue.

B. Var. *linearis*, Hook. & Tayl.

5. On trees, East Taeri bush, Otago, N. Z.: W. L. L.: in fruit, and spermogoniferous. Spores and thecæ have the characters of the type, and of var. *Richardii*. From these the plant differs only in its size, being smaller in all its parts; but it passes, by imperceptible gradations, into both. Thallus comparatively smooth, with few fossæ or rugæ.

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* Linds. "Observations on New Lichens and Fungi from Otago, N. Z.," Trans. Royal Soc. Edin. p. 449, plate xxx. figs. 48, 49, 51, 52.

Apothecia frequently degenerate, consisting of pale or flesh-coloured irregular granulose buttons or tubercles, the disk having fallen away, leaving only the hypertrophied hypothecium. Spermogones sparingly distributed.

There are, I think, no sufficient characters for separating *Richardii* and *linearis* as varieties, and still less as species; they are mere conditions, characterized by different size and division of thallus. Moreover all forms of *S. fossulata* so greatly resemble in all their essential characters the variations of our British *S. pulmonacea*, Ach., that I am disposed to refer them to a single species. *S. fossulata* is even commoner in New Zealand than *S. pulmonacea* is in our forests and woods; and it there appears to take the place of the latter, which is a northern form or species. In the Dunedin district of Otago, *S. fossulata* is one of the commonest *Strictæ*; and the forms, which have narrow linear thalline segments, are sometimes among the most elegant *Stictæ* to be found in any part of the world. So close do I consider the alliance between *S. fossulata* and *S. pulmonacea*, that I think it probable the southern may be employed for the same purposes in the arts or in medicine as the northern form (if the economical applications of the latter plant are now considered of the slightest importance). To *S. fossulata* belong various *Stictæ*, sent me by Dr. Hooker in 1856, or which occur in the Kew Herbarium, under the names:—

1. *S. impressa*, Tayl. [Linds. Spermog. p. 198, plate x. fig. 26.]
2. *S. carpoloma*, Dél. [Linds. Spermog. *l. c.*; Bab. L. N. Z. p. 12, plate cxxvi.]
3. *S. foveolata*, Dél. [Bab. L. N. Z. p. 14, plate cxxiv.]
4. *S. cellulifera*, Tayl. [Bab. L. N. Z. p. 14, plate cxxiv.]

6. Sub nom. *S. impressa*, Tayl. N. Z.; Dr. Hooker, Antarctic Expedition 1839–43: (fig. 4:) in my herbarium: abundantly in fruit and spermogoniferous.

Spores ellipsoid, 1-septate, dark brown, sometimes so dark and granular that the septum is invisible. Iodine has the effect of increasing the intensity or depth of this brown colour, and consequently adding to the obscurity of the septum. Thecæ obovate. Apothecia sometimes with a pitchy-black colour, in the absence of the growth of *Celidium* or other parasite. Spermogones cover the transverse rugæ of the thallus as very minute, depressed, brown points, which are the ostioles leading to the immersed bodies.

7. Sub nom. *S. linearis*, Hook. & Tayl. Tasmania; Dr. Hooker, Antarct. Exped.: in my herbarium. The spermogones are exactly those of No. 6. The thallus in both cases is narrow, and approaches the *linearis*-character. In the New Zealand plant, however, the under surface of the thallus is pale buff-coloured, smoothish, though marked by reticulated rugæ or by granular projections, but without any fur or cyphellæ; whereas in the Tasmanian plant the colour is dark brown, especially centrally, the surface is subpilose and granulose, with distinct white pseudo-cyphellæ.

8. Sub nom. *S. carpoloma*, Dél. New Zealand; Dr. Hooker: Rio and other districts of Brazil, Graham, &c.; in herb. Kew: exhibits no distinguishing characters worthy of note.

9. Sub nom. *S. crocata*, Ach. New Zealand; Dr. Hooker, Antarct. Exped.: in my herb., in fruit: is, I think, referable here, though its cyphellæ are citrine yellow instead of whitish. Spores broadly ellipsoid, 1-septate, brownish. Thecæ longish, obovate superiorly: blue with iodine.

Sp. 2. S. PHYSCIOSPORA, Nyl. L. N. Z. (Fig. 6.)

On the trunks of dead trees, Saddle-hill bush, Otago: W. L. L.

Spores resemble in character those of the preceding species; they are broadly ellipsoid, 1-septate, in the young state frequently polari-bilocular (*a*), the loculi united by a central longitudinal canal; in the old state(*c*) the loculi breaking up into four (sometimes more) irregular granular masses, separated by imperfect interspaces; brown, ·0006″ to ·0009″ long, ·0003″ to 00045″ broad. Paraphyses subdiscrete, filiform, united at their apices, which are obscured by much brownish granular colouring-matter. Thecæ ·0024″ to ·0030″ long, ·0006″ to ·0009″ broad. Hymenium blue with iodine. Spermatia rod-shaped, ·00012″ long, ·00005″ broad, seated on straight indistinct arthrosterigmata.

All the essential characters of this species are those of the preceding, to which I do not hesitate to refer it as a mere form. The character on which Nylander apparently founds his species—the polari-bilocular or physcioid spores—is not a constant or distinctive one, inasmuch as, we have already seen, it occurs in various forms of *S. fossulata*; and we shall hereafter find it occurs also in other *Strictæ*.

Sp. 3. S. ORYGMÆA, Ach. (Fig. 7.) [Linds. Spermog. p. 199, plate x. figs. 23 & 24.]

1. On dead trees, Saddle-hill bush; on living trees, East Taeri bush, Otago: W. L. L.: abundantly in fruit and spermogoniferous, spermogones being, however, most numerous and best seen on specimens bearing few scattered apothecia.

Spores ellipsoid or fusiform, colourless, 1- to 3-septate (in young apothecia 1-septate, this appearing to be the normal state of mature spores; in old apothecia 3-septate); ·0015″ long, ·0003″ broad. Thecæ ·0030″ to ·0036″ long, ·0006″ to ·0009″ broad; with the hymenium generally, blue under iodine. Apothecia crowded centrally; many of them degenerate, the disk having fallen away, exposing the yellow medullary tissue of the thallus, which is also seen in various reticulated fissures of its cortical layer. Spermogones mostly peripheral on the thallus. Thallus sometimes very handsome, 6 to 8 inches across, colour glaucous above, gamboge-yellow below.

2. Chatham Islands: Dr. Müller, Melbourne: in my herbarium; apothecia and spermogones abundant. (Fig. 8.)

Spores, in the thecæ 1-septate, vary from colourless to brown. Thecæ ·0030″ long, ·0008″ broad. Hymenium very beautiful when seen in section and under iodine, almost exactly as in *S. subcoriacea* [Nyl. L. N. Z. 247; Linds. Obs. N. Z. Lich. and Fungi, p. 420, plate xxix. figs. 34–36]. Spermogones occur on the rugæ over the whole thallus, though they are most conspicuous on those outside the region occupied by the apothecia and about the periphery of the thallus. Spermatia in myriads, ·00015″ to ·00020″ long, ·00005″ broad; on delicate indistinct arthrosterigmata ·0009″ to ·0012″ long, and ·0001″ broad. The thallus is frequently stained in patches a beautiful purple, as I have noticed also in various alpine lichens, such as *Platysma cucullatum*, Hoffm., which have a lemon-yellow thallus. I attribute this coloration to the action of the ammonia produced by the decay of the droppings of birds on the colorific principles of the lichen-thallus.

3. Auckland Islands: Dr. Hooker, Antarct. Exped.: in my herbarium. Apothecia and

spermogones as plentiful as in the Otago plant, with most of whose characters these specimens agree. (Fig. 9.) Spores (*b*, *c*) ellipsoid, 1-septate, pale yellow. Thecæ (*a*) largish, blue with iodine. Paraphyses delicate, scarcely coloured at their heads.

4. Auckland Islands and Chiloë: in herb. Kew. Spermogones abundant and distinct, scattered among the apothecia, especially on the thalline rugæ; brown, punctiform, seated in or forming palish, papillar, thalline elevations—having thus a subpapillæform character. Arthrosterigmata indistinct, granular, irregularly branching. Spermatia in myriads, short, straight, rod-shaped. Patches of the cortical layer of the thallus have been destroyed by erosion, exposing the bright-yellow medullary tissue.

In a specimen from New Zealand sent me by Dr. Hooker [sub nom. *Sticta flava*], in fruit (fig. 10), the spores are colourless, fusiform, 1- to 3-septate, tapering and sometimes subtubular (preparing for germination) at ends.

Sp. 4. S. URVILLEI, Dél. (Fig. 11.) [Linds. Spermog. 200.]

1. On the trunks of dead trees, East Taeri and Saddle-hill bush, Otago: W. L. L.: apothecia and spermogones plentiful.

Spores ellipsoid, 3-septate, pale olive or brown, ·0009″ to ·0012″ long., ·0003″ broad, external wall (epispore) sometimes showing slight bulgings (*b*) opposite the loculi; ends of old spores sometimes tapering off into a tube prior to germination (*c*). Hymenium blue with iodine; its constituents closely aggregated and obscured by abundance of dark-brown colouring-matter.

A. Var. *flavicans*, Hook. & Tayl. [Linds. Spermog. 199.]

2. On the trunks of dead trees, East Taeri bush, Otago: W. L. L.: in fruit, and spermogoniferous.

Thecæ 8-spored, ·0036″ long, ·0006″ broad; with hymenium generally blue with iodine. Paraphyses discrete, filiform, united at their tips, which are brown and tuberculiform. Thallus smoothish, especially when compared with the following variety; pale buff-coloured; medullary tissue gamboge-yellow, showing itself conspicuously wherever there are cephalodia or isidia on, or erosions or fissures of, the cortical layer; lobes sometimes multifid.

3. Chatham Islands: Travers, Jun., from Dr. Müller, Melbourne: in my herbarium, in fruit. (Fig. 12.)

Spores narrowly ellipsoid or fusiform, somewhat variable, especially as to size, ·0009″ long, ·0001″ broad, colourless, 1- to 3-septate (3-septate in old state). Thecæ ·0024″ to ·0030″ long, ·0006″ to ·0008″ broad, very pale blue with iodine. Paraphyses discrete, delicate, filiform, loosely united by pale brownish-yellow tuberculated tips. Hymenial constituents distinct and easily examined in section; hymenium one of the most beautiful among all the *Sticteæ*. The margins of the thalline lobes are copiously and minutely multifid. These lobes being also subimbricate, the whole thallus sometimes appears covered with squamulose isidioid growths, or it has a furfuraceous or granulose aspect. If mere conditions of the lichen-thallus, however marked, when not constant, are to be separately designated, this form is entitled to be called and considered variety or form *multifida.* But I regard such divisions and designations as not only useless, but mischievous, adding to the existing complexity and confusion of classification by a multiplication of names already excessive. Indeed this so-called variety, *flavicans*, presents in specimens even from the same locality, and much more so from different countries, the following variations:—

Thallus smooth, or fossulate and rugose, or covered more or less with squamules or granules; sterile or fertile, the former more generally smooth and paler in colour, the latter more usually fossulate and darker in tint; edges of lobes entire or more or less divided, becoming squamulose or granulose. Apothecia isolated and few, or crowded, peripheral or central on the thallus, or both. Spermogones more or less crowded.

4. Sub nom. *S. flavicornis*, Tayl. (probably an error for *flavicans*). Falkland Islands, and Hermite Island, Cape Horn: Dr. Hooker, Antarct. Exped.: in my herbarium. Hermite-Island specimens (fig. 13) have the characters partly of *S. Urvillei*, of its var. *Colensoi*, and of *S. orygmæa.* Thallus very rugose and fossulate, edges of lobes much curled and subsquamulose or granulose. Spermogones abundant, scattered about periphery of thallus as blackish-brown dots, generally depressed; in the old state irregular in form, radiate or stellate (ostioles); the internal walls consist of closely aggregated irregular arthrosterigmata, resembling those of *S. orygmæa.* In Falkland-Island specimens spermogones are less plentiful but also peripheral, more distinct, from the paler colour of thallus, more generally seated in the centre of slight thalline papillæ with flattened apex, the ostiole being subdepressed and brown-punctate.

B. Var. *Colensoi*, Bab. [*Sticta Colensoi*, Bab. L. N. Z. p. 10, pl. 123.]

5. Associated with var. *flavicans*, East Taeri bush, Otago: W. L. L. Differs chiefly in its thallus being much roughened and obscured by yellow isidia.

6. Sub nom. *Nephroma cellulosa*, Ach. Hermite Island: Dr. Hooker, Antarct. Exped.: in my herbarium: seems referable here; sterile. It has probably been so labelled and associated by mistake, and is really a New-Zealand plant.

Specimens of *S. Urvillei*, from the Straits of Magellan, are infested by the parasitic *Lecidea orygmæa*, Nyl.

I am not satisfied that there is sufficient ground for distinguishing *S. Urvillei* and *S. orygmæa* as separate species, nor *flavicans* and *Colensoi* as separately named varieties. All are generally abundantly spermogoniferous and fructiferous, with thalline lobes much divided at their edges into squamules of varying size and character.

Sp. 5. S. DISSIMULATA, Nyl., var. *multifida*, Laur. (Fig. 14.) [Nyl. L. N. Z. 248.]

1. On the trunks of dead trees, East Taeri and Saddle-hill bush, Otago: W. L. L.: in fruit.

Spores (*f*) ·0009″ to ·0015″ long, ·00025″ to ·00045″ broad; vary in form from broadly ellipsoid or oval-oblong to fusiform; in young state simple or 1-septate, in old state sometimes 3-septate; olive or brown, according to age. Thecæ (*c*, *d*) ·0024″ to ·0036″ long, ·0006″ to ·0009″ broad; 8-spored; with hymenium generally, pale or beautiful blue with iodine (*d*). Paraphyses (*b*) discrete, filiform, ·0045″ long; with yellowish-brown tuberculiform heads, sometimes obscured by a considerable amount of brown granular colouring-matter, covered by a yellowish membrane (*a*). Hypothecium (*e*) brown. Apothecia, when old, frequently lose disk, partly or wholly, by erosion, exposing the hypothecium, and leaving flattish or subconvex shields of irregular form. Margins of thalline lobes much and irregularly laciniose or subisidioid; general surface of thallus sometimes also covered more or less with minute squamules, giving it a subfurfuraceous character.

Sp. 6. S. RUBELLA, Hook. & Tayl.

1. On trunks of dead trees, Greenisland bush, Otago: W. L. L.: sterile; one of the most beautiful New-Zealand species, distinguished by the brilliant or deep crimson red of the cortical layer, and the equally beautiful gamboge-yellow of the medullary tissue of the thallus. The latter is frequently exposed in erosion-patches of the cortical layer, and in the isidioid soredia, which are not uncommon.

Sp. 7. S. AURATA, Ach. [Linds. Spermog. 200.]

1. In my herbarium: New Zealand*: Dr. Hooker, Antarct. Exped.: sterile; erroneously labelled *S. crocata*. Long Island, North America: A. O. Brodie, No. 2135 (also sterile): has a thallus of the colour of that of *S. pulmonacea*, from which tint to the rich crimson of *S. rubella*, the forms of *S. aurata* present every variation in shade.

2. In herbarium Kew: Waiheke Island, N. Z. [Auckland Province]: Milne, H.M.S. "Herald," 1855: frequent on trunks of trees in the forests. Ngesi, Fiji: Milne, H.M.S. "Herald," 1855: in fruit. Norfolk Island, 1855: common on trees in the woods, and also on the high grounds. Pacific Islands: thallus deep crimson, sterile. St. Helena: Dickson, 1804, and Mrs. Wilde: sterile. In Dickson's specimens, the whole cortical tissue is eroded, the subjacent yellow medullary tissue being thus generally exposed; well deserving, in this condition, its name *aurata*. In Mrs. Wilde's specimens, decortication is nearly as extensive or general. Organ Mountains, Brazil (fig. 15). Spores normally and generally 1- (sometimes 3-) septate, ellipsoid, colourless in young state (*a*), becoming sometimes brown with age (*b*); ·0008″ to ·0010″ long, ·0002″ broad. Apothecia abundant, marginal; flat, large disk of a deep lake-colour, border subfoliaceous. Thallus brownish red, no yellow soredia, nor fissures of cortical layer. Peru: thalline margins generally abundantly sorediiferous, soredia of a beautiful saffron-yellow. This species is sometimes second in beauty only to *S. rubella*, but is seldom fertile. In Europe its thallus is the site of a fungiform parasitic *Celidium* (*C. Pelvetii*, Hepp. Exs. Nos. 372 and 589; Linds. "Observations on New Lichens and Fungi from Otago, N. Z.," Trans. Roy. Soc. Edinb. p. 450).

Sp. 8. S. LATIFRONS, Rich. (Fig. 16.) [Nyl. L. N. Z. 246; Bab. L. N. Z. 13.]

1. On trunks of dead trees, Saddle-hill bush; on living trees, East Taeri bush: W. L. L.

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* All the lichen-collections of Dr. Hooker during the Antarctic Expedition of Sir James Ross in 1839–43 were, so far as I am aware, made exclusively in the province of Auckland, North Island.

On trees, Signal Hill, Dunedin: Dr. Sinclair. Otago, N. Z. All in fruit. One of the most abundant and handsome Otago *Stictæ*.

Spores fusiform, straight or slightly curved, colourless, usually 3-septate, sometimes 1-septate or simple, exceptionally 4- to 5-septate (*b*), ·0015″ long, 00025″ broad, but varying somewhat both in size and form, sometimes elongated at extremities prior to germination (*c*). Thecæ ·0045″ long, 0009″ broad, 8-spored, beautiful pale blue with iodine. Paraphyses very delicate, filiform, indistinct, united closely at their yellow tuberculiform heads. Hymenial gelatine and paraphyses not affected by iodine. Apothecia very variable, in old state especially; disk becomes sometimes deep brownish red, or brownish black, or pitch-black, variously concave and urceolate, or convex and biatorine, or irregular; frequently, also, they are degenerate, the disk being wholly or partly eroded or destroyed, or the whole apothecium falls entirely out, leaving only an irregular scar or aperture in the thallus, where the apothecium was formerly seated; margin or exciple may be entire and symmetrical, or it may rise above or fall below the depressed or turgescent disk, or it may become rugose and irregular, or it may disappear, leaving a biatorine disk. Thallus ½ to 1 foot broad, generally more or less smooth, surface occasionally roughened by minute granules; colour variable, lemon-yellow to lurid (dark blackish brown), herbarium specimens sometimes olive-green or brown; surface sometimes slightly fossulate, especially towards base; segments sometimes retuse, like those of *S. pulmonacea*, though generally broadly rounded; edges entire or little divided, sometimes erose and laciniate, ragged and irregular.

Some forms of the Otago plant closely agree with Babington's plate 122 [L. N. Z.], of his var. *Menziesii*.

Sp. 9. S. DAMÆCORNIS, Ach. [Linds. Spermog. 194].

1. In herbarium Kew, sub nom. *S. macrophylla*, Hook: New Zealand, 1853: very different from the Irish form. Thallus of a saffron-yellow tinge; apothecia abundant but degenerate; disk eroded and whitish, shrivelled; hypothecium left; no spermogones.

Java, Lobb (fig. 17), on the other hand, seems exactly the Irish plant. Segments of thallus about the size of those of *S. pulmonacea*, smoothish, not fossulate. Apothecia marginal. Spores ellipsoid or fusiform, 1- to 3 (or more)-septate, according to age; ·0013″ long, ·0002″ broad. Thecæ ·0033″ long, 0006″ broad.

The Hookerian herbarium contains other forms, from Rio (Dr. Lyell) (narrow-lobed), St. Domingo (Schomburgk), Madras, &c.; which I fail to distinguish from forms of *S. dissimulata* and *S. Freycinetii*.

Like the majority of the *Stictæ*, this species is a most variable one, and its forms, I believe, may be properly made to include several New-Zealand and other *Stictæ* at present regarded as separate species. The colour of the under surface of the thallus, though usually blackish brown or buff, is sometimes, as I have seen it in fructiferous Irish specimens of var. *macrophylla* Bab. [Killarney, Taylor], gamboge-yellow, resembling the smoother, simpler forms of *S. Urvillei*. The cyphellæ, which are studded over it, may be large or small, distinct or the reverse, and of all shades of colour between brown and green. The under surface of the thallus may also be almost smooth, or finely granulose, or densely pilose, or pubescent. The degrees of division of the thalline lobes, which are usually more or less entire, are almost equally diverse.

Sp. 10. S. FREYCINETII, Dél. [Linds. Spermog. 197.]

1. On trees, East Taeri bush; on columnar basalt, Greenisland Bluff, Otago: W. L. L.: both forms sterile. Thallus very isidiiferous, with much-curled margins.

2. Sub nom. *S. glabra*, Tayl. (Fig. 18.) [Linds. Spermog. 201, plate x. figs. 13, 14.] Falkland Islands: Dr. Hooker, Antarct. Exped.: in my herbarium; in fruit. Spores broadly ellipsoid, 1-septate within their thecæ (*a*), 3-septate when old (*b*), pale brown or brownish yellow. Thecæ (*a*) largish, 8-spored, blue with iodine. Paraphyses discrete, delicate, filiform.

3. In herbarium Kew: Cape Horn; Falkland and Auckland Islands: Dr. Hooker: on *Plagiochila*, springs, Mount Wellington, Tasmania. Plant sterile in most of these cases, and generally so: in fruit in Auckland-Island specimens, in which the thallus is decorticated in patches, exposing the white medullary tissue. In Falkland-Island specimens the thallus is irregularly sorediiferous, and its colour varies from pale straw-yellow to olive or brown. Were this form Scotch, it would probably be referred to *Sticta scrobiculata*, Ach., or *Stictina limbata*, Sm.

The apothecia of *S. Freycinetii* are sometimes changed in appearance by the growth thereon of the black parasitic *Celidium Stictarum*, Tul. (Figs. 26, 27.) The deformity produced is the basis of variety *Delisea*, Bab. L. N. Z., and of the genus *Delisea* of Fée [Nyl. Syn. 365]*.

Sp. 11. S. GRANULATA, Bab. (Fig. 19.) [Nyl. L. N. Z. 247, *Stictina*; Nyl. Syn. 340.]

1. On trunks of dead trees, Greenisland bush, Otago: W. L. L.: sterile. On trees, Signal Hill, Dunedin, sterile; Auckland, in fruit: Dr. Sinclair.

Spores ellipsoid, or oval-oblong, brown, 1-septate, sometimes physcioid (*a*), as in *S. fossulata* and *S. physciospora*; ·0006″ to ·0009″ long, ·0003″ to ·00045″ broad. Thecæ 8-spored, ·0024″ to ·0030″ long, ·0009″ broad. Paraphyses subdiscrete, apices closely aggregated, and concealed by brownish-yellow granular colouring-matter. Hymenium blue with iodine, contains a large amount of free oil globules of all sizes. Thallus usually sterile, glaucous, margins and surface more or less copiously covered with soredia, or isidia, or both. The smaller forms are sometimes very elegant, the thalline segments fringed with copious marginal white soredia, or coralloid granulations. The plant is well named, if it is to be considered a separate species. The thallus is apt, like that of other *Strictæ*, to be infested with black parasitic maculiform *Celidia**.

Genus II. STICTINA, Nyl.

Sp. 1. S. DISSIMILIS, Nyl.

1. On trees, Christie's bush, Saddle-hill; on trunks of dead trees, and on stockyard palings of "Goai" timber, Martin's bush, Chain Hills; in crevices of the mica slate, and

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* Linds. Obs. N. Z. Lichens and Fungi, p. 452, plate xxx. figs. 49–52.

on the matted and exposed roots of various herbs or shrubs, ravines of the Chain Hills, Otago: W. L. L.: in all cases sterile, but spermogones sparingly distributed in some specimens. The plant is of a Peltigeroid type, and resembles in general aspect our *S. sylvatica*. The thallus is of a dull or dirty lurid or brown, a colour that is unusual among the New-Zealand *Stictæ*, in which more brilliant tints, especially yellow, predominate; its margins are generally more or less fringed with coralloid granulations, (resembling young states of *Sphærophoron* or *Stereocaulon*), which are really extremely minute squamules. In this tendency to multifid division of the edge of the thallus, and in other features, this species resembles *Sticta dissimulata*, and so closely that I know of no sufficient characters for their specific separation. Moreover *Stictina dissimilis* and *Sticta dissimulata*, in their variations, resemble, save as to the colour of the medullary tissue, *Sticta Urvillei*. They have, further, many characters in common with *Sticta damæcornis*.

Sp. 2. S. CROCATA, Ach.

1. In herbarium, Kew: New Zealand, 1853. Waiheke Island (Auckland): Dr. Joliffe. Both sterile.

On rocks, Coal River, near Richmond, Tasmania, both sterile and fertile. Sterile specimens are abundantly sorediiferous, the soredia being yellow and both marginal and central; thallus brown or chestnut-coloured, with a somewhat lacunose surface. Plant has a general resemblance to the British *Sticta scrobiculata*. Fertile specimens are non-sorediiferous. Apothecia chiefly central and crowded, a few marginal; substipitate, base of attachment to thallus slight; disk deep brown, border generally regular, thin, sometimes waved or involute. Spores ellipsoid, 1-septate, brown (apothecia mostly old), ·00066″ to ·00083″ long, ·00033″ to ·00040″ broad.

Swan River (West Australia). (Fig. 20). Apothecia abundant, scattered over the thallus, subpedicellate, margin thick and rugose, becoming thin as the chestnut-red disk expands with age and flattens, and always more or less wavy or wrinkled. Spores ellipsoid, brown, 1–3-septate. Thallus dark brown, with few soredia. Plant has a general resemblance to *Sticta linita*, Ach.; some forms, especially in the young state of the apothecia, are very handsome.

St. Helena: Dr. Seemann: sterile, associated with *Sticta aurata*. Colour of thallus very pale brown, surface marked by the growth of small, cushion-like, bullose, suberect lobes.

Another British species, *S. fuliginosa*, Dicks., occurs in New Zealand. A sterile specimen in my herbarium, from Tarndale, Nelson, Dr. Sinclair, is indistinguishable from what I have collected in the Pass of Leny (Callander, on rocks, May 1859). In a specimen in herbarium Kew, from Tavistock, 1837, there are abundant submarginal apothecia, disk brownish red, border simple, thin; spores (fig. 22) ellipsoid, colourless, normally 1-, sometimes becoming 3-septate. *Abrothallus Smithii*, Tul. (fig. 28), which is parasitic on its thallus in Britain, may at least be looked for on New-Zealand specimens, if the plant prove to occur there in any plenty.

Sp. 3. S. FRAGILLIMA, Bab., var. *lutescens*, Krempelhuber. [Linds. Spermog. 198; Nyl. L. N. Z. 246.]

1. Tarndale, Nelson, N. Z.: Dr. Sinclair: in my herbarium; sterile; one of the most graceful of the New-Zealand *Stictæ*, characterized by its beautiful lemon-yellow colour, and its long, narrow, channelled, much-divided laciniæ. The colour is often dark brown about the base of the stem; and the thallus exhibits various shades of green, according to the degree of exposure to, or protection from, light. Sometimes it exhibits here and there various shades of red or brown, or it is variegated red and yellow. The upper surface of the thallus, especially towards the end of its segments, is sometimes roughened with a covering of minute granulations or isidioid tubercles, resembling those of the *Usneæ*. The margins and tips of the laciniæ are sometimes fringed with minutely lobulate proliferous growths, which frequently become long and ribbon-like. Occasionally there is patchy decortication of the thallus, or there are median and longitudinal fissures of the laciniæ.

Gen. III. RICASOLIA, De N.

Sp. 1. R. CORIACEA, Hook. & Tayl. (Fig. 23.) [*Sticta*, Bab. L. N. Z. p. 19, plate 125 A; Linds. Spermog. 204.]

1. On trees, East Taeri bush, Otago: W. L. L.: in fruit, and spermogoniferous.

Spores ellipsoid or fusiform, 1- to 3-septate, brown or olive, ·0012″ long, ·00045″ broad. Thecæ blue with iodine, ·0036″ to ·0045″ long, ·0006″ to 0009″ broad. Paraphyses subdiscrete, very delicate and indistinct, not much exceeding in length the thecæ, united by very pale brownish-yellow tuberculiform heads. Hymenium in section one of the most beautiful to be found among the *Stictæ*. Thallus tomentose about its periphery and margins, covered with fine whitish hairs, which also copiously clothe the exciples of the apothecia, especially in their young, globose, unexpanded state.

2. Auckland: Dr. Sinclair: in my herbarium; also in fruit. Thallus and apothecia less tomentose than in Otago specimens; characters otherwise the same.

Sp. 2. R. MONTAGNEI, Bab. [Nyl. L. N. Z. 248, *Sticta*; Bab. L. N. Z. 20.]

1. On trunks and branches of dead trees ("Goai" and others), Greenisland and Saddle-hill bush, Otago: W. L. L.: in fruit. A common corticolous form in the Dunedin district of Otago. It resembles in general characters *R. herbacea* (fig. 24), having, like it, the aspect of a *Parmelia*. The thallus varies in colour from very pale buff to lurid (dark-brown), and possesses the heavy disagreeable odour peculiar to so many of the *Stictæ*. Sometimes its surface is rugose, and approaches the fossulate character of *S. pulmonacea*. Its margin, as well as the exciple of the apothecia, is sometimes covered with isidioid or squamulose growths. The cortical layer is sometimes eroded, exposing the subjacent medullary tissue. The spores and thecæ are exactly those of *R. herbacea*, to which *R. Montagnei* appears to me to be referable as a mere form.

II. *The New Zealand* PARMELLÆ *and other Lichens.*

Genus I. PARMELIA. (Plate LXI.)

Sp. 1. P. PERFORATA, Ach. [Linds. Spermog. 211.]

1. *a. Corticolous* forms. On the trunks of trees, living or dead (especially "Goai"). Saddle-hill and Greenisland bush: apothecia and spermogones abundant.

b. Saxicolous forms. On various trap-rocks, Forbury Heads; on Basalt, Greenisland Bluff; on mica-slate and gneiss, Gabriel's Gully, Tuapeka: sterile, spermogoniferous or not. All in Otago, N. Z.: W. L. L.: one of the most abundant, largest, and handsomest of the New-Zealand *Parmeliæ.*

Spores abundant and distinct, oval-oblong, simple, colourless, with double contour in maturity, ·00045″ long, ·0003″ broad. Thecæ broadly obovate above; with hymenial gelatine, beautiful blue under iodine; ·0024″ long, ·00075″ broad. The apothecia are sometimes the site of the parasitic *Microthelia Cargilliana*, Linds.[*]; and the thallus, of the parasitic *Abrothallus Curreyi*, Linds.[†]. Apothecia on corticolous specimens generally abundant, often crowded, deeply cup-shaped, especially in young state, becoming with age expanded and attenuated, often irregularly split up into segments extending nearly to the centre of the disk; with involute or evolute thin margins; basal perforation only occasionally visible. Spermogones, where they occur, generally distinctly black-punctate and peripheral; in the old state they become large, irregular in form, and subconfluent [‡]. Thallus variable, especially in regard to the smoothness of its surface and the presence or absence of marginal black cilia or fibres. Sometimes, even in the same specimen, some of the thalline lobes may possess these cilia while others are naked. The cilia vary, moreover, in their length, thickness, and closeness of aggregation. Their occurrence is much too inconstant and unimportant to be the basis of a separately named variety *ciliata* (Nyl. Syn. 378). Cilia occur both in corticolous and saxicolous forms, though they are most common and best developed in the former.

Saxicolous forms are sometimes of considerable size, from ½ to 1 foot in diameter. The thallus frequently becomes very thick and coriaceous, and much reticulated by fissuring of the cortical layer. Soredia also common, and sometimes abundant, grey more generally than white, fringing the peripheral lobes only, or clothing the margins of the curled, crowded, subimbricate central lobes, or generally covering the whole thalline surface. Saxicolous sterile states are frequently associated with forms of *P. saxatilis* and *P. lævigata.*

On subjecting the thallus, especially of saxicolous forms, to ammoniacal maceration, I found, while in Otago, that it yielded the same series of colours as are furnished in northern countries, under similar treatment, by *P. perlata* [§], viz. tints varying from sherry-red through port-wine red, and various brownish reds or reddish browns, to a very rich chocolate-brown.

2. In herbarium, W. L. L.: Rio Janeiro, Henry Paul: finely fruited. Spores oval,

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[*] "Observations on New Lichens and Fungi from Otago, N. Z.," Trans. Royal Soc. Edinb. vol. xxxiv. p. 439, plate xxx. figs. 31–34.

[†] *Ibid.* p. 409, plate xxix. figs. 1–5.

[‡] *Ibid.* p. 409, plate xxix. figs. 1–3.

[§] "Experiments on the Dyeing-properties of Lichens," Edinb. New Phil. Journal, Oct. 1854, and July 1855.

simple, pale yellow, with a broad hyaline border, resembling, save in size, those of certain *Pertusariæ*. Thecæ deep blue with iodine. Paraphyses indistinct, with pale-brownish tips. Spermogones abundant. Thallus smooth, glaucous; lobes fringed with long graceful black cilia; sometimes so narrow as to resemble forms of *P. lævigata*: under surface smoothish or rugose, or finely granulose, destitute of fibrillæ; buff, or various shades of brown.

Long Island, North America: A. O. Brodie, 1856: in fruit, and spermogoniferous. Upper surface of thallus in age sometimes reticulate-fissured, the exposed medullary tissue having a saffron-yellow or red colour; marginal cilia shorter than in Rio specimens: under surface partly fibrillose-rhizinose, the fibres being as long as the marginal cilia.

3. In herbarium Kew (which contains a large and valuable suite of specimens, especially from warm or tropical countries). Sikkim, Himalayas (fig. 2): var. *denticulata*, Linds. [Spermog. p. 212, plate xi. figs. 6, 7]. Spores oblong or oval, simple; endospore pale yellow; external envelope blue with iodine (*a*) (an unusual phenomenon in lichen-spores): ·0008″ long, ·0004″ broad.

Chinar, Kumaon, Himalayas, 8700 feet: Strachey and Winterbottom. Spores of same character as those just described, large and very handsome, ·001″ long, ·0005″ broad, oval, with a broad hyaline margin and pale-yellow endospore (fig. 1). The collectors observe, "Full-grown apothecia *perforate and imperforate in the same specimen*," a circumstance that is common in this species from all parts of the world where it occurs. Thallus with marginal cilia.

Chongtam, Sikkim, reg. temp., 6000 feet: Dr. Hooker: margin partly ciliate, partly sorediiferous. Kollong, Khasia, reg. temp., 5000 feet: Drs. Hooker and Thomson: is indistinguishable from our *P. perlata*. Simla, Himalayas: Dr. Thomson: has no marginal soredia, and also resembles our ordinary British forms of *perlata*. Madras: Dr. Hunter: is slightly ciliate, and is labelled "*perforata*;" while a similar specimen, also from Madras (Dr. Wright) is labelled "*perlata*,"—both by Dr. Nylander.

On rocks, Organ Mountains, Brazil: Lardner, No. 6898. On trees, near Jalapa, Mexico, 3000–4000 feet: H. Galeotti, 1840. Ohio: Lea and Peck. New Orleans, Boston, U. S. A.: Boott. Pacific Islands; Portugal, C. L. S. da Arrabida: Welwitsch, No. 81. And many others in herbarium Kew. Do not differ in any essentials from those already described, all being more or less variable, and sometimes equally puzzling. Apothecia perforate or not, the former sometimes in proportion to the age of the apothecia, which are frequently large and substipitate. Thalline margins generally more or less ciliated, sometimes coarsely so. Spermogones generally abundant and conspicuous.

An examination of extensive suites of forms of *P. perforata* and its allies on the one hand, and of *P. perlata* and its allies on the other, satisfies me that all are properly referable to only two species:—the one represented by our common *P. perlata*, embracing all the British and the majority of foreign forms of both *P. perforata* and *P. perlata*; the latter consisting entirely of a few foreign, mostly Indian, forms, which appear to be designated *P. megaleia* by Nyl. (Syn. 378), and *P. latissima* by Fée (Nyl. Syn. 380). The latter forms (figs. 1, 2), which I would refer to *P. megaleia*, Nyl., bear the same relation to *P. perlata* that *P. pertusa* does to *P. physodes*. The distinction consists in their constantly large handsome spores, which are pertusarioid rather than parmelioid, with an endospore pale yellow and separated from the epispore by a broad hyaline margin. Excluding *P. megaleia* as a good species (altogether foreign so far as I am at present aware), the forms of *perforata* and *perlata* pass into each other by imperceptible gradations. In all essential respects they are indistinguishable: their spores and spermatia, apothecia and spermogones, are the same. So variable is the plant, and so inconstant are its variations, that I do not think we are justified in maintaining in our classifications as a separately named variety either *perforata*, *denticulata*, or *ciliata*, these being merely conditions of the most changeable kind. What we call *perlata* is mostly saxicolous, northern, sterile and destitute of cilia. *Perforata* is a much larger and handsomer form, affecting warmer countries, more frequently corticolous, and then generally fertile; its apothecia are generally also larger and handsomer than in the forms which characterize colder countries. Even in warm or southern countries, however, the plant has sometimes the aspect of the ordinary or ciliate Scotch *P. perlata*, or the Irish *P. reticulata*, Tayl., or *P. proboscidea*, Tayl.

In the herbarium Kew, and in all herbaria I have examined, public or private, there is almost inextricable confusion regarding the nomenclature of the various forms of *P. perforata* and its allies, no two authorities naming the same specimen in the same way. If the spores, as I propose, be made the basis of classification (and they furnish the only good or constant character I have been able to discover), this confusion will be abolished by referring *all* forms to two types: 1, the British *P. perlata*; 2, the Indian *P. megaleia* (figs. 1, 2).

Sp. 2. P. PERLATA, Ach. (Fig. 3.) [Linds. Sperm. 208, plate xi. figs. 8–12.]

1. *a. Saxicolous* form. On rocks and stones, on the Greenisland hills and Saddle-hill; on basaltic blocks strewn about the Forbury Heads, Dunedin; on tertiary grits and sandstones, Woodburn ravine, Saddle-hill: all in Otago: one of the commonest saxicolous *Parmeliæ* of Otago: W. L. L.

On the trachytic rocks which encompass the Pukaki lake, north shore, opposite the town of Auckland; and on the trachytic and other rocks (hard basaltic tuffs, &c.) which form Beeson's or Wanganui Island, in the harbour of Coromandel, province of Auckland, N. Z. (in fruit): W. L. L.

b. Corticolous form. On trees, Botany Bay, New South Wales, March 1862: furfuraceous state, in fruit: W. L. L.

The saxicolous forms are for the most part sterile, and sometimes devoid of marginal cilia. They have much of the aspect of the common British saxicolous forms. Ammoniacal infusion of the thallus exhibits the same colour as in *P. perforata*, from which, as before explained, it appears to me not to differ in any essential respect.

2. In herbarium Kew, sub nom. *P. cristifera*, Tayl.: Brazil, Gardner, 1839. (Fig. 3.) Seems only a form with curled lobes, marginal soredia, and large handsome apothecia. Spores simple, broadly ellipsoid or ellipsoid-oblong, colourless, ·0006″ long, ·0003″ broad. Thecæ 8-spored, blue with iodine; ·0025″ long, ·001″ broad.

On Abyssinian specimens of *P. cristifera* in herbarium Kew, I found a form of *Abrothallus Smithii*, Tul., var. *microspermus*, Tul., parasitic, whose spores (fig. 38) differ from those common in European forms in that they are colourless in the young and mature state, only acquiring a brown or olive colour (never very deep) with age.

Sp. 3. P. PERTUSA, Schrank. (Figs. 4, 5.) [Linds. Spermog. 226; *P. diatrypa*, Bab. L. N. Z. 22.]

1. *a. Corticolous* form. On trunks of living and, more generally, dead trees, Martin's bush, Chain Hills; Greenisland bush: on branches of trees, East Taeri bush: on Stockyard palings of "Goai" timber, Chain Hills, Otago: W. L. L.: in fruit, and spermogoniferous (sparingly).

b. Saxicolous form. On basaltic blocks on the hills about the Forbury, Dunedin, Otago: W. L. L.

One of the commonest corticolous *Parmeliæ* of Otago, taking the place of its ally *P. physodes*, and generally fertile.

Spores (fig. 4*b*) resembling those of *P. megaleia*, than which, however, they are generally broader and more subspherical. They are very distinct, beautiful, and pertusarioid, oblong-ellipsoid; endospore pale yellow, and separated from the epispore by a broad, distinct hyaline margin; ·0012″ long, ·00075″ broad. Thecæ (*a*) very broadly saccate and arthonioid in type, with scarcely any pedicle, here 8-spored; with the hymenial gelatine, beautiful blue under iodine (coloration extending over whole theca, and not, as is general in lichens, occurring only or most deeply at the apex); ·0024″ long, ·0018″ broad. Paraphyses delicate and indistinct. Thallus generally coriaceous and subrigid, contrasting in this respect with *P. physodes*. Sterile conditions are frequently sorediiferous or isidioid, the soredia having mostly a central distribution on the thallus.

2. In herbarium Kew (fig. 5): Ballycheulish, 1807: in fruit. Thecæ 2-spored, ·0033″ long, ·0020″ broad, blue with iodine. Spores oval-oblong or subspherical: endospore pale yellow; margin broad, hyaline: ·0013″ long, ·0010″ broad.

Rocks at Glengariff and Ballylichey: Miss Hutchins, 1810. Beddgelert, Wales, 1802. British specimens have a general (sometimes in the blackness of the edges and under surface of the thalline segments a special) resemblance to var. *enteromorpha* of *P. physodes*. Largish white soredia are common on the thallus, especially towards the periphery. Wallanchoon, Sikkim, reg. alp., 13,000 feet (Drs. Hooker and Thomson): is quite the Irish plant. Riesengebirge: Dr. Ludwig, 1814. &c.

The plant has a strong general resemblance to *P. physodes*, from which, however, it is separated by its spores, just as *P. megaleia* is separated from *P. perforata*. Their number in each theca varies from two to eight (Nylander says 2–4, Syn. 402), a circumstance that never occurs in *P. physodes*, which, like the genus *Parmelia*, generally possesses 8-spored thecæ.

Sp. 4. P. PHYSODES, Ach., var. *enteromorpha*, Ach. (Fig. 6.) [Linds. Spermog. 223.]

1. On branches of trees, Christie's bush, Saddle-hill, Otago: W. L. L.: in fruit, and abundantly spermogoniferous. The apothecia frequently resemble those of *P. perforata*

in their being irregularly cup-shaped, expanded and attenuated, involute or evolute, and split up into wedge-like pieces: they are inferior, however, in size. The spermogones are often very closely crowded or confluent, giving the tips of the laciniæ a black-punctate character which is visible to the naked eye. Apothecia and thalline laciniæ subfistulose.

Auckland: Dr. Sinclair: in my herbarium. Spermogoniferous, but no apothecia; under surface and edges of laciniæ black; tendency to perforations or erosions of the character of those in *P. pertusa*; quite agrees with the Otago plant. A specimen from Colenso, in fruit, in herbarium Kew, seems more referable to the type than to this variety.

2. Suite of southern or antarctic specimens in my herbarium, collected by Dr. Hooker, Antarctic Expedition.

Tasmania (fig. 6): on twigs of bushes, and on trees. Spores (*d*) very small, oval, or subspherical, narrowly but distinctly margined in maturity; colourless, simple, resembling in size and form those of the genus *Usnea.* Thecæ (*b*) short, blue with iodine. Paraphyses (*a*) with pale-brown tips. Spermogones those of the type [Linds. Spermog. 200], crowded, black, punctiform. Apothecia as in Otago specimens. Thallus partly lobate, with a subfossulate surface, resembling in this respect broad-lobed forms of *P. saxatilis*; appressed and flat; laciniæ not terete nor subfistulose; of a faint greenish-yellow tinge, probably an herbarium effect.

Hermite Island, Cape Horn: in fruit. Spores very small. Thecæ short, broadly obovate above, blue with iodine. In microscopical details it resembles the Tasmanian plant; but the thallus is much smaller and blacker: in size it does not exceed ½ to 1 inch; the blackness extends to both sides or surfaces of the minute laciniæ; and the whole plant has much the aspect of a *Lichina*, or some small cespitose melanospermous marine *Alga.*

Falkland-Island specimens resemble the preceding forms in their blackness and size, both of which characters appear to bear a close relation to the degree of cold, being developed to the greatest extent in arctic and antarctic regions.

The form *enteromorpha* represents in the southern hemisphere the typical or ordinary northern forms of *P. physodes*; as doing so, and in virtue of its comparatively well-marked distinctive external characters, it is one of the few lichens which merit separate name and place as *varieties.* It is not, however, exempt from *variations*, which pass into the type and are sufficiently puzzling. Usually it is sterile. The laciniæ vary from fistulose and terete to flat and appressed; sometimes they are channelled below and convex above; generally they are more or less narrow or linear. Blackness of colour is a general characteristic: it is always to be found on the *under* surface, and very frequently it extends in patches to the edges of the laciniæ; sometimes their *upper* surface also is black-mottled, and less frequently the whole upper surface assumes a uniform pitchy blackness.

Sp. 5. P. LÆVIGATA, Ach. (Figs. 7, 37, 42.)

1. On columnar basalt, Greenisland Bluff, spermogoniferous; on gneiss, Gabriel's

Gully, Tuapeka, Otago: W. L. L. Saxicolous forms are generally sterile, with sometimes marginal black cilia (as in *P. perforata*) and lateral globose soredia.

2. Var. *sinuosa*, Sm. Occurs occasionally intermixed with the type in saxicolous forms in Otago; common at Tuapeka; on basaltic blocks, flanks of Kaikorai-hill, near Dunedin: sometimes in fruit, more frequently sterile, seldom distinctly isidioid or sorediiferous.

3. Var. *sinuosa*, Sm., (sub nom. *Parmelia sinuosa*, Sm., var. *relicina*, Fr.) in herbarium Kew, from Wallanchoon, Sikkim, reg. temp., 10,000 feet: Dr. Hooker: sterile. Thallus and its soredia (which are terminal or peripheral, and prominent) lemon-yellow. One specimen, devoid of soredia, has bullose dilatation of one of its lobes, bearing, and probably produced by the growth of, a parasite, whose general habit is that of *Abrothallus oxysporus*, Tul., but whose spores are rather those of *A. Curreyi*, Linds. The thalline bullosity is similar to what occurs sometimes in *Parmelia conspersa*, *P. olivacea*, and *Platysma glaucum*, L.[*], when they are affected by the parasitic *Abrothallus oxysporus*. The apothecia of this interesting form of *Abrothallus Curreyi* (interesting as an important connecting link between the species of *Abrothallus* which have simple and those which have bilocular spores) are flat, dark brown when dry, beautiful light chestnut when moistened. Thecæ broadly obovate superiorly; ·00133″ long, ·00066″ broad. Spores (fig. 37) crescent-shaped, generally more curved than in *Ramalina*; typically bilocular; in the mature spore the loculi, as in *Ramalina*, occupy nearly the whole cavity of the epispore, being separated only by a narrow linear septum; in the young state polari-bilocular, or subphyscioid, as in various of the *Stictæ* [†]; ·0005″ to ·00066″ long, ·00020″ to ·00025″ broad. In their bilocularity they resemble the spores of New-Zealand forms of *A. Curreyi*; but they differ in their curvescence, and somewhat also in their form. In the absence of colour, and in their form (save their curvescence), they also approach the characters of those of the British and New-Zealand forms of *A. oxysporus*[‡].

4. Var. *reticulata*, Tayl., (sub nom. *Parmelia reticulata*, Tayl., or *P. sinuosa*, Sm., var. *reticulata*, Tayl.) in my herbarium, and in herbarium Kew. New Zealand: Dr. Hooker, Antarct. Exped.: sterile, but bearing a few spermogones about the ends of the laciniæ, similar in external appearance to those of *P. saxatilis*[§]. Laciniæ broadish, sometimes minutely digitate, tipped with well-marked soredia, margins and under surface generally black-fibrillose, though sparingly. Taylor's *P. reticulata* is neither good as a species nor as a variety; it is a mere cracked condition of a subcoriaceous thallus, which may occur in saxicolous exposed forms of *P. perforata*, *P. perlata*, or *P. lævigata*. According to my examination of the suite of specimens in the Kew herbarium, it is mostly referable either to *P. perlata* or *P. lævigata*. *P. reticulata*, Nees, is a different plant, a Cape species, referable to *P. Hottentotta*, Ach.

5. Var. *revoluta*, Flk. (Fig. 7 *a*.) [Linds. Spermog. 218.]

On branches of trees, Saddle-hill bush, Otago: W. L. L.: associated with *Usnea barbata*, Fr., var. *ceratina*, Ach.: spermogoniferous. Spermogones externally resembling those of *P. tiliacea*; they are abundant, scattered among the apothecia, minutely subpapillæform; ostiole black or brownish black; body brownish black, immersed. Spermatia in myriads, very delicate straight rods or needles, ·0002″ long, ·00005″ broad, on delicate, narrow, jointed sterigmata about ·0009″ long, from among which project into the cavity of the spermogone elongated delicate filaments (*a*), with rounded, somewhat thickened ends, subramose and resembling those of many other *Parmeliæ* (Linds. Spermog., plates xi. & xii.). These spermogones are in all respects of true parmelioid type.

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[*] Linds. "Monograph of Abrothallus" (with two coloured plates), Quart. Journ. of Microscopical Science, January 1857, fig. 9, pp. 13–16.

[†] Section on the New Zealand *Stictæ* in the present paper, Plate LX. figs. 1, 2, 3, 6, 19.

[‡] Obs. Otago Lich. & Fungi, p. 410, plate xxix. fig. 6.

[§] Lindsay, Spermog., 210, 217.

6. Var. *revoluta*, Flk. (Fig. 7 *b–h.*)

On twigs, Auckland: Dr. Sinclair: in my herbarium, in fruit. Indistinguishable, save as a form (and that not a constant or distinct one) from the type. Spores (*f–h*) oblong-oval or subspherical, colourless, simple, margined in maturity, variable somewhat both as to form and size, ·0003″ to ·00045″ long, ·00025″ broad. Thecæ (*d*) 8-spored, blue with iodine, ·0021″ long, ·0006″ broad. Paraphyses delicate, indistinct, agglutinated at their tips, which become yellow under iodine (*c*). Hymenial gelatine blue with iodine (*d, e, h*); the hymenium in section (*b, e*), especially under iodine, is extremely beautiful, and furnishes an excellent illustration of the structure of the parmelioid apothecium, exhibiting:—

1. The agglutinated tips of paraphyses, yellow (*c*).
2. The bodies of the filiform paraphyses, colourless (*d*).
3. The thecæ of different ages and sizes, blue (*d*).
4. The hypothecial cellular tissue, pale brownish (*e*).

Sp. 6. P. CONSPERSA, Ach. (Fig. 8.) [Linds. Sperm. 231.]

1. Copiously coating the basaltic cliffs in various gullies of the Greenisland hills; common on basaltic blocks strewn over the hills about the Forbury, Dunedin; on Signal-hill, North-east Valley, Dunedin; on Saddle-hill and Kaikorai Hill—on basalt *in situ* on the two latter hills up to their summits (1565 and 1092 feet); on slaty traps and trap conglomerates, Ferry bluff, Clutha Ferry; on slaty basalt, Kapuwaka Creek, Finegand station, Lower Clutha; and generally one of the most common lichens on basaltic or trappean rocks and boulders in the eastern districts of Otago; equally common, however, on tertiary sandstones, grits, and conglomerates, in the Tokomairiro district, and around Saddle-hill,—as well as on the metamorphic slates (gneiss), Tuapeka, (mica-slate) Chain-hills, (talc-slate) Otokia bluff, Saddle-hill. The plant occurs in equal abundance fertile, spermogoniferous, and sterile: frequently isidioid or sorediiferous; occasionally bearing (*e. g.* in Greenisland specimens) the parasitic *Abrothallus oxysporus*, Tul.*

Spores (fig. 8) oblong-ellipsoid, simple, colourless, margined in maturity, ·0003″ long, ·00025″ broad. Thecæ 8-spored, ·0009″ to ·0012″ long, ·0003″ to ·0006″ broad. Hymenium blue with iodine; its constituents (paraphyses and thecæ) indistinct. Thallus generally resembling that of the British plant (*e. g.* in regard to the size and divisions of the laciniæ, the smoothness of the surface, or its covering with isidia); but it is very variable, becoming, on the one hand, broad-lobed and smooth, passing into *P. caperata*, and, on the other, minutely laciniate, passing into *P. Mougeottii*. Frequently the laciniæ resemble in size those of *P. lævigata* in some of its varieties (e. g. *sinuosa*). Sometimes they have thickened black edges, then appearing as if bounded by a lateral black rib. The plant is frequently associated on the same rock or boulder with *P. caperata* and *P. Mougeottii*, species with which it is constantly confounded in herbaria. The transition-stages, indeed, are so gradual between these three presently so-considered species, and their essential characters are so much alike, that it would be quite in accordance with nature to refer all, as mere forms or varieties, to a single type.

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* Linds. Obs. Otago Lich. & Fungi, p. 410, plate xxix. fig. 6.

I found *P. conspersa* abundant on the hard basaltic tuffs of Wanganui or Beeson's Island, Coromandel Harbour, Auckland province (in fruit, Feb. 1862); and there is every reason to consider it not only one of the most common saxicolous lichens of Otago, but of New Zealand, differing in no essential from, and just as variable as, the British plant.

2. In herbarium Kew: New Zealand, Colenso; on rocks and trees, Bay of Plenty, in fruit, Dr. Joliffe, 1853. Thallus, especially when sterile, roughened with isidioid growths, just as in Otago and Scotch specimens.

P. moniliformis, Bab. (Linds. Spermog. 220) from new Zealand, Colenso, Nos. 863 and 2685, in herbarium Kew, seems, if not a mere form of *P. conspersa*, at least closely allied thereto.

Sp. 7. P. CAPERATA, Ach. (Fig. 9.) [Linds. Spermog. 207, plate xi. figs. 13, 14.]

1. On basaltic boulders, summit of Kaikorai Hill, near Dunedin, Otago: W. L. L.: associated with forms of *Physcia stellaris* and *P. parietina*.

Spermogones abundant, prominent, central on the thallus, black-punctiform, immersed in thalline verrucosities, having quite the characters of those common in *P. caperata* rather than *P. conspersa*. Spermatia straight rods, ·0002″ long, ·00005″ broad, seated on sterigmata which are unusually distinct, frequently becoming granular and yellow under iodine, composed of several delicate, narrow, sublinear cellules, ·0009″ to ·0012″ long, and ·00008″ broad.

The plant I here consider *caperata*, Nylander refers, in my herbarium and in that of Kew, to *P. conspersa*; and I find in all herbaria great contrariety of opinion and great confusion as to the true position of the large-lobed forms of *conspersa*, and the small lobed forms of *caperata*, which, indeed, are simply transition-stages from the one plant into the other. The classification of these forms must always be arbitrary and changing, unless we place both plants under one species, and refer all its forms with broad, rounded, smooth lobes to var. *caperata*, and those with sublinear rough laciniæ to *P. conspersa*.

In my herbarium there are some forms of *P. caperata* from the Queen's Park, Edinburgh, collected by Don, with divisions of the thallus quite as narrow as in the ordinary forms of *P. conspersa*. In herbarium Kew there are various North American forms (north-west coast, Douglas; Arctic America, Franklin's first journey; Quebec, Morrison) which, though as large-lobed as many conditions of *caperata*, are referred by Nylander to *conspersa*. In the same herbarium, also, there are sterile isidioid specimens of *P. caperata* from the North Island, N. Z.: Colenso.

To the passage-forms between *conspersa* and *caperata*, I refer *P. Tasmanica*, Tayl., from Tasmania (Gunn), in my herbarium: in fruit, and spermogoniferous. The spermogones are abundant, black and punctiform; but their external character is that of those of *P. conspersa* rather than that of *P. caperata.* (Linds. Spermog. 233, plate xii. figs. 39, 40.)

Sp. 8. P. Mougeottii, Schær.

1. On tertiary grits and conglomerates, base of Saddle-hill, in fruit; on mica-slate, Glen Martin, Chain-hills, Otago: W. L. L.: a common saxicolous lichen in the Greenisland district, but less common than *P. conspersa.* Apothecia sometimes black or deep chestnut-brown; convex and lecanorine or subbiatorine, differing considerably from those usual in *P. conspersa.* Thallus much more minutely divided than in *P. conspersa*, laciniæ narrower and darker, and the whole plant much smaller. But in regard to all essential characters the plants are the same; the hymenium, thecæ, paraphyses, and spores are exactly as in *P. conspersa*; and therefore I am led to regard *Mougeottii* as merely a small form of *conspersa.* Some Otago specimens, labelled *Mougeottii* by Nylander, in my herbarium, have the apothecia, as well as laciniæ, of *conspersa.*

Sp. 9. P. saxatilis, Ach. [Linds. Spermog. 226.]

1. Common on various trappean rocks and boulders, mostly basaltic, about the Forbury, Dunedin; Signal-hill, North-east Valley, Dunedin; on the "Big Rock," Saddle-hill; on talc slate, Otokia Bluff; on slaty traps and trap conglomerates, Ferry-bluff, Clutha Ferry (in fruit). The plant seems as variable as in Britain, but is much less common. It is generally sterile, sometimes ochraceous, or exhibiting in whole or in part various shades of red. Some forms are what would be in Scotland named var. *omphalodes*, Fr. (*e. g.* on the Forbury cliffs); while others, with very small, narrow, blackish laciniæ, approach, or are, the European alpine var. *panniformis*, Schær. (*e. g.* Ferry-bluff, lower Clutha).

2. In my herbarium, suite of specimens from Hermite Island, Cape Horn: Dr. Hooker, Antarct. Exped.: all sterile. Exhibit, passing into each other, the conditions known in Europe as *omphalodes, panniformis leucochroa* (Wallr.), and *furfuracea* (Schær.). Of these, none appear to me to deserve separate place or name, save, perhaps, *omphalodes*, whose bronze-colour is a somewhat constant character.

Submitted to ammoniacal maceration, Otago specimens yielded a rich chocolate-brown colour, instead of the fine red it sometimes furnishes in northern countries[*]. Its thallus is sometimes the site of the parasitic *Abrothallus oxysporus*, Tul., in Otago[†]; and *A. Smithii*, Tul., or other parasitic lichens, as well as *Dothidea homostegia*, Nyl., *Dothidea Pigottii*, Berk. & Broome, or other parasitic fungi which infest its thallus in Britain, may be found also to occur thereon in New Zealand.

Sp. 10. P. olivacea, Ach. [Linds. Spermog. 234.]

1. On basaltic rocks or boulders, Saddle-hill; on mica-slate, Glen Martin, Chain-hills, Otago: W. L. L. Hitherto apparently found only in the North Island (Bab. L. N. Z.).

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[*] "Experiments on the Dyeing-properties of Lichens," Edinb. New Philos. Journ. July 1855, p. 19.

[†] Obs. Otago Lich. & Fungi, p. 410, plate xxix. fig. 6.

In herbarium Kew: North Island (Colenso). Resembling var. *omphalodes* of *P. saxatilis,* for which it has been mistaken.

Both Otago and Auckland specimens are sterile and saxicolous forms, exactly resembling parallel British conditions.

Genus II. Physcia, Nyl. (Plate LXI.)

Sp. 1. P. chrysophthalma, L. (Fig. 10.) [Linds. Spermog. 252.]

1. On "scrub" (the twigs of shrubs), East Taeri bush, and about the head of Otago Harbour, Otago: W. L. L.: sterile, and in fruit; associated with *Verrucaria epidermidis* and other common corticolous lichens. Spores ellipsoid, polari-bilocular; loculi pale yellow, connected by a median, longitudinal, linear septum; central portion colourless; ·00045″ long, ·00020″ broad. Thecæ 8-spored, ·00024″ long, ·00045″ broad. Hymenial gelatine beautiful blue with iodine. Thallus occasionally showing patches of white, as in British specimens, attributable to decolorization or blanching, not to decortication or erosion. Hitherto found only in North Island (Bab. L. N. Z.).

2. Tarndale, Nelson, apparently terricolous or saxicolous, sterile; Auckland, on twigs of bushes or branches of trees, in fruit: both in herbarium of Dr. Sinclair. The Auckland plant has large, prominent apothecia, with few thalline laciniæ, whitish towards their bases; a beautiful form. The Tarndale plant has narrow and much divided laciniæ of the beautiful vermilion tint of *Placodium elegans,* DC.

Sp. 2. P. parietina, De. N. (Fig. 11.) [Linds. Spermog. 250.]

1. Saxicolous forms. On trap rocks and boulders, top of Kaikorai Hill (1092 ft.), and on Saddle-hill; on tertiary grits and conglomerates, base of Saddle-hill; on mica- and talc-slate, Otokia Bluff; on slaty traps and trap conglomerates, Ferry-bluff, Clutha Ferry; on slaty trap, Shaw's Bay, the Nuggets.

2. Corticolous forms. On dead trunks of "Goai" and on living "Totara," Greenisland bush: frequent in fruit; majority of forms indistinguishable from the ordinary British plant. Minutely laciniose forms (var. *lychnea,* Nyl.) are also common; and *Lepraria flava,* Ach., on "Totara"-bark, Greenisland bush, is probably a rudimentary condition of *P. parietina.* Betweent his leprarioid condition and var. *lychnea,* and between the latter and the ordinary forms of the plant, all gradations occur. Though more or less common, especially the saxicolous forms, the plant seems less so than in Britain. As in Britain, it is frequently associated with forms of *P. stellaris.* In some forms, approaching *lychnea,* the thallus has a deep vermilion colour, and the apothecia are mostly terminal, seated on the tips of the laciniæ. The thallus frequently displays various shades of green, depending apparently, as in the yellow *Stictæ,* on the degree of moisture and light to which the plant has been exposed in its place of growth. Sometimes the cortical layer is eroded in patches, exposing the white medullary tissue. The apothecia are sometimes crowded, and of a dull, dark hue.

Spores (*a*) oblong-ellipsoid, colourless, polari-bilocular, ·0003″ to ·00045″ long, ·0002″ to ·0003″ broad. Thecæ (*a*) 8-spored, ·0024″ long, ·00045″ broad. Hymenium beautiful blue with iodine (*a*); its constituents very distinct: hence this is one of the best species wherein to study the structure of the apothecia of *Physcia*. Paraphyses discrete, very distinct, filiform, stoutish, with thick tuberculate heads, consisting generally of two to four subspherical cellules, full of granular green colouring-matter, and superimposed in a moniliform manner (*b*). A few spermogones occur about the periphery of the thallus occasionally, as orange-red minute papillæ; but they are mostly old and degenerate, and possess their usual character in this species.

3. In herbarium Kew. On twigs of bushes of various kinds, Uitenhage, South Africa: Cape (Drège); on greenstone rocks, close to the sea, George Town, Demerara, 1844, associated with *P. chrysophthalma*. These Cape and South American forms are partly labelled var. *aurea* by Nylander in herbarium Kew; they pass on the one hand into *chrysophthalma*, and on the other into *flammea*, the passage-forms being frequently most puzzling. The Cape forms especially are liable to be confounded with var. *Capensis*, Ach., of *chrysophthalma*. The colour of the thallus is frequently the vermilion of *flammea*; the apothecia are frequently substipitate; and the laciniæ tend to become terete and bullose, or inflated at their extremities, as in *flammea*.

Sp. 3. P. FLAVICANS, DC. [Linds. Spermog. 253, plate xiv. fig. 20.]

I found specimens referable, I think, to this species (which has not hitherto been found in New Zealand), without fruit, from the Dun Mountain, Nelson, in the herbarium of the late Dr. Sinclair, R.N., at Auckland.

Sp. 4. P. STELLARIS, Fr. (Fig. 12.) [Linds. Spermog. 243.]

1. Form *radiata*, Ach., Nyl. (Fig. 12.) On dead trunks of "Goai," Greenisland bush: very like specimens of *P. picta*, Sw., which I collected on weathered fabricated timber, old palings of the Zoological Gardens at Botany Bay, New South Wales. Spores oblong-ellipsoid, 1-septate, brown, ·00075″ to ·0009″ long, ·0003″ broad. Hymenium blue with iodine.

2. Form *congesto-laciniata*, Nyl. On trappean boulders, top of Kaikorai Hill: sterile; associated with *P. parietina* and *Parmelia conspersa*.

In herbarium Hooker, a form from the North Island (Colenso), on tree-barks, is associated with what has the external aspect of *P. obscura*, Fr. Saxicolous forms appear to pass into *P. cæsia*, Fr., of which I found typical specimens agreeing with the British plant, on slaty traps, Shaw's Bay (Linds. Spermog. 246, plate xiii. figs. 30, 31).

Genus III. UMBILICARIA.

Sp. 1. U. POLYPHYLLA, Hffm. [Linds. Spermog. 185, plate ix. figs. 6, 7.]

On gneiss, Gabriel's Gully, Tuapeka, at an elevation of about 1500 feet above the sea: sterile. Babington (L. N. Z. 3) remarks on the absence of the genus *Umbilicaria* from the lichen-flora of New Zealand as one of its peculiar features. But the discovery of this common and widely-diffused species at a comparatively low elevation warrants the conclusion that, when the New-Zealand *Alps* are examined for their lichens, other representatives of this genus may be looked for. So far as we at present know, the genus is certainly extremely rare in the temperate and frigid regions of the *southern* as contrasted with similar countries in the *northern* hemisphere. The species abound in the arctic and cold parts of Europe* and America; and they are also distributed over many temperate, and even tropical countries (Peru and India—in the latter occurring, however, on the mountains, where they frequently have a great altitudinal range). *U. polyphylla* is one of the species which occur at low elevations in Scotland; so that it must be regarded as equally lowland and montane; and it is widely spread over Europe, America, and Asia.

Genus IV. NEPHROMA, Ach. (Plate LXI.) [Linds. Spermog. 172, plate ix. figs. 28–34.]

Sp. 1. N. ANTARCTICUM, Jacq., var. *tenue*, Nyl. (Fig. 13.)

On trunks of dead trees, East Taeri bush, Otago: W. L. L.: sterile, fertile, and spermogoniferous. Spores narrowly ellipsoid, 1–4-septate, colourless or pale yellow (*a*, *b*), ·0006″ to ·0009″ long, ·00025″ to ·0003″ broad. Thecæ 8-spored. Hymenium pale blue with iodine. Spermogones (where they occur) abundant, marginal, minute roundish brown tubercles or teeth, fringing certain thalline lobes, prominently visible on the white under surface of the thallus. Spermatia (*c*) in myriads, atomic, subglobose or oval-oblong, about ·00006″ in diameter, endowed with vivid Brownian movement. Apothecia occur on the same specimens with the spermogones; large, difform, prominent on the white underside of the thallus. Thallus (upper surface in sterile forms) resembles in colour and smoothness the handsomer forms of *Parmelia caperata*; but its smooth white underside, with the prominent and very different apothecia and spermogones, at once indicate the generic distinction. The plant is uniformly handsomest in its sterile forms.

I cannot distinguish the Otago plant by any sufficient character from what Nylander (Syn. 321) calls *Nephromium cellulosum*, Ach., as it occurs in Hermite Island, Cape Horn (Dr. Hooker, Antarctic Expedition; in my herbarium). The apothecia and their contents are identical essentially, as is the sterile thallus—the fertile thallus being larger and more fossulate. Spores fusiform, 3-septate, brown. Thecæ and paraphyses shortish, not blue with iodine. Tips of paraphyses of a dark-brown colour, which extends downwards to their base. This coloration of the spores and paraphyses is common in the *old* state of the apothecia in many of the higher or foliaceous lichens, *e.g.* the *Stictæ* and *Peltigeræ*; and the non-reaction with iodine of the lichenine of the thecæ and hymenium points also to the fact that the apothecia in these specimens are old and becoming degenerate. The fertile thallus is the siteo f a parasitic *Microthelia*, *M. Alectoriæ* (Linds. Spermog. 135, plate i. figs. 12, 13).

Nor does *Nephroma arcticum*, Fr., (Fig. 14,) [Nyl. Syn. 316,] as it occurs in herbarium Kew, appear to differ in good characters from *N. antarcticum* or from various species of *Nephromium* (*N. cellulosum*, Ach., *N. tomentosum*, Hffm., or *N. lævigatum*, Ach.). The spores (*a*, *b*) are virtually the same, fusiform or narrowly ellipsoid, 3-septate, brown with age (*b*), ·0006″ to ·0008″ long, ·00016″ broad. Indeed Nylander's subdivision of the

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* They are profusely distributed in Norway for instance: *vide* "Contributions to the Lichen-flora of Northern Europe," Journal of Linnean Society (Botany), vol. ix. p. 380.

Nephromata into the genera *Nephroma* and *Nephromium* appears to me unnecessary, and founded, as in the parallel secession of *Stictinæ* from *Stictæ*, on a single character of minor significance—the form of the gonidia.

Genus V. PELTIGERA. (Plate LXI.)

Sp. 1. P. RUFESCENS, Hffm. (Fig. 15.) [Linds. Spermog. 174.]

On trunks of dead trees, East Taeri bush, in fruit. Apothecia and portions of the thallus cæsio-pruinose. Spores (*b*) narrowly fusiform, colourless, polyseptate, ·0015″ long, ·0006″ broad. Thecæ (*a*) 8-spored, ·0036″ to ·0045″ long, ·00045″ broad. Paraphyses discrete. Hymenium beautiful blue with iodine; constituents distinct. This is the only species of its genus I found in Otago; it occurs in my herbarium only from one locality, and the specimens are very poor. So far as my own experience goes, the genus *Peltigera* is apparently as rare in the eastern districts of Otago as *Umbilicaria*. But Babington (L. N. Z.) describes *P. polydactyla*, Hffm., as "very abundant in New Zealand." He records further the occurrence of *P. spuria*, DC., in both the northern and southern islands; and it is probable, therefore, that further botanical research may prove the genus to be more common throughout New Zealand than it has yet been ascertained to be. Like *Umbilicaria*, the genus *Peltigera* is much more largely represented in the northern than in the southern hemisphere, both as regards the number of species and individuals, and the degree of their development. More especially do they luxuriate in the forests of Europe and North America. Some forms are cosmopolite; others prefer cold or alpine regions. Within the tropics they appear to be rare, though, like *Umbilicaria*, they are to be found sometimes in the alpine regions thereof (*e. g.* the Himalayas and Abyssinian Alps).

I am disposed to refer *P. rufescens*, *P. spuria*, *P. polydactyla*, as well as certain other species presently so called, to one type, the common *P. canina*, Hffm.

Genus VI. COLLEMA.

Sp. 1. C. LEUCOCARPUM, Tayl.

On trees, East Taeri bush, sterile, associated with *Psoroma sphinctrinum*, Mnt., var. *pholidotoides*, Nyl.; on trees, Martin's bush, Chain-hills, apothecia abundant, associated with *Pannaria gymnocheila*, Nyl.: both in Otago: W. L. L. Spores fusiform, polyseptate. Thecæ 8-spored, ·0024″ long, ·0006″ to ·00075″ broad. Hymenium blue with iodine. Paraphyses scarcely exceeding in length the thecæ; subdiscrete subtuberculated tips, obscured by granular pale-brown colouring-matter. Apothecia buff pruinose, sometimes very prominent on the greenish-black thallus, occasionally abortive and degenerate in the young state, appearing as small tubercles, which may become confluent, and may somewhat, externally, resemble spermogones. Thallus varying in colour and texture, sometimes (especially when sterile) subdiaphanous and of a beautiful pure leek-green; fructiferous forms are more generally duller or blackish green, or of a dark slate-colour.

In some New-Granada and Tasmanian specimens in the herbarium Kew, spermogones are abundant as minute peripheral or subperipheral tubercles, having essentially the characters of those of other *Collemata* (Linds. Spermog. p. 270, plate xv.).

On the damp faces of cliffs and rocks, in gorges or ravines, in the Greenisland and Chain hills, and in similar localities, I met with other *Collemata* apparently identical with common home forms, which, however, have not been preserved in my herbarium, and have therefore probably been lost during, or destroyed by, transport. The genus appears to be fairly represented in New Zealand, though not to the same extent as in Britain. When, however, we are thoroughly acquainted with the lichen-flora of the extremely moist *west* coast of Otago, the number of the *Collemata* may prove to be much greater than that at present known.

Genus VII. Leptogium. (Plate LXI.)

Sp. 1. L. bullatum, Ach., (Fig. 39,) which occurs in New Zealand, according to Nylander (Syn. 129), is essentially a plant of tropical countries. In herbarium Kew there is a good suite of specimens, including forms from :—

a. Jamaica (Purdie, sub nom. *Collema aphthosum*, Hook. fil. & Berk.), on twigs of bushes and on trees.

b. Hot country at western base of the Andes (Jameson).

c. Himalayas (Strachey and Winterbottom).

In Jamaica specimens the spores (*a*, *b*) are broadly ellipsoid or oval, 1–6-septate, the loculi submuriform, ·001″ long, ·0005″ broad. Thalline laciniæ bullose, bearing on their apices the apothecia, which generally appear subsaccate. Only in the bullose laciniæ does the plant seem to me to differ from the cosmopolite *L. tremelloides*, Fr., which appears to be abundant throughout New Zealand, occurring variously on mosses, earth, stones, or trees.

In a specimen from Rio Janeiro (Paul. 1846) in my herbarium, the thecæ are deep blue with iodine—and the spores (*c*) muriform, resembling those of *Urceolaria scruposa* or *Lecidea petræa.*

Genus VIII. Lichina, Ag.

Sp. 1. L. pygmæa, Ag. [Linds. Spermog. 268; sub nom. var. *intermedia*, Bab. L. N. Z. 47, plate 128 *c*.]

On rocks, Otago, 1850; probably collected by Dr. Lyall: in herbarium Kew. Does not differ from the common British plant.

Spores oblong-oval, simple, ·001″ long, ·00033″ broad.

Genus IX. Ramalina. (Plate LXI.)

Sp. 1. R. calicaris, Ach. (Fig. 16.) [Linds. Spermog. 127.]

On trunks and branches of trees, Saddle-hill and Stoney-hill Bush; on dead trunks of "Goai," Greenisland Bush, Otago: W. L. L.: all in more or less abundant fruit.

Spores (*a*, *b*) oblong-ellipsoid, straight or more generally slightly curved, colourless, 1-septate, ·00045″ long, ·00015″ broad. Apothecia terminal or subterminal, frequently seated at the angles of the laciniæ; disk often cup-shaped, brownish yellow, contrasting with the pure pale lemon-yellow of the smooth, glistening thallus. Thalline laciniæ generally sublinear, very thin, subdiaphanous, frequently canaliculate, with involute margins, which give them a subfistulose, subterete character, often fossulate, reticulated, or striated to various degrees, frequently angulose or geniculate towards their extremities, this subacute angularity depending apparently on the development of the apothecia. Most forms of the Otago plant are referable to the type, and agree with var. *geniculata*, Bab. L. N. Z., which is a mere condition, undeserving separate nomenclature. Some forms become sufficiently broad, especially towards the ends of the laciniæ, to approach var. *fastigiata*, Fr. All the broader commoner British forms, such as *fraxinea*, appear to be rare in New Zealand. The laciniæ of the Otago plant are apt to be infested with a parasitic microscopic *Microthelia*, *M. ramalinaria*, Linds. (Spermog. 130; Obs. Otago, Lich. & Fungi, p. 440, plate xxx. figs. 44–6), which is sometimes so abundant and so conspicuous as to render them black-punctate.

a. var. *Eckloni*, Spr. (Figs. 17, 18.) [Var. *membranacea*, Laur., Bab. L. N. Z.] On the trachytic rocks which form the banks of the Pukaki Lake, north shore, Auckland: W. L. L.: in fruit. An ill-defined form, undeserving of separate name or place in classification. There are passage-forms between it and the type on the one hand, and the larger forms on the other. Specimens labelled "New-Zealand Moss," from the [East] India Museum, sent me as a dye-lichen by my friend M. C. Cooke, in October 1860, differ from the Otago plant only in being stouter and approaching more to *fastigiata*. The same plant apparently (sub nom. *R. fastigiata*, Fr.) occurs in the Museum of Economic Botany, Kew, and was displayed in the Great Exhibition of 1851, as "False Orchella Weed" from New Zealand. This may be the lichen shown in the New-Zealand Exhibition of 1865 (at Dunedin) as "Orchilla Weed," from the north shore, Auckland, and which is probably a *Ramalina*, inasmuch as, on the one hand, there is as yet no proof of the occurrence of any species of *Roccella* in New Zealand, while, on the other, various forms of saxicolous *Ramalinæ*, occurring on or near sea-coasts, have greatly the aspect and habit, and, to a limited extent, the tinctorial properties, of that genus. *R. scopulorum* is more likely to be mistaken for a *Roccella* than (especially corticolous) forms of *R. calicaris*; but though I have specimens in my herbarium of *R. scopulorum* from the Chatham Islands, I have seen none in any herbarium from the north or south islands of New Zealand. I have had the same lichen, *R. Eckloni*, from Lisbon (*viá* Liverpool—collected perhaps on the coasts of some of the Portuguese possessions in Central Africa, eastern or western—intermixed with true "Orchella Weed" imported for the British orchil-manufacture), sent me by the Rev. W. A. Leighton (1856). In these specimens (fig. 17), which are fructiferous, the spores (*b*) are oblong-ellipsoid, 1-septate, colourless, straight or curved, generally the latter. Thecæ (*a*) blue with iodine.

Specimens of *Eckloni* in herbarium Kew, on *Mangifera Indica*, Mauritius, have a very variable thallus, which is sometimes dwarf and broad, approaching *fraxinea*, at other times longish and narrow, approaching *calicaris*. Apothecia marginal or scattered over the thalline segments. Spores (fig. 18) oval-oblong, 1-septate, ·0005″ long, ·0002″ broad. Thecæ ·0016″ long, ·0006″ broad.

b. Var. *linearis*, Sw. (Fig. 19.) Merely a long, filiform, usneiform condition. In Mexican specimens in herbarium Kew, the apothecia are lateral, distributed mostly at the angles of the laciniæ, as in the geniculate forms of *calicaris* in Otago. Spores (fig. 19) somewhat more elongated than in their usual condition in *calicaris*; simple, and herein deviating from the typical or common condition, though sometimes with faint traces of a central septum; oblong-ellipsoid, straight or curved, ·0005″ long, ·00016″ broad, colourless.

Sp. 2. R. SCOPULORUM, Ach. (Fig. 20.) [Linds. Spermog. 128, plate v. figs. 13, 14.]

1. Chatham Islands (Travers, jun.), sent me by Dr. Müller, Melbourne, 1865; in fruit, but apothecia in great part degenerate and difform.

Spores colourless, 1-septate, ·0004″ long, ·0002″ broad; but variable as to size and form, oval or oblong, straight (*a*) or slightly curved (*b*) (seldom so), sometimes subpyriform, occasionally with a constriction opposite the septum, and (according as the upper segment of the spore is of equal size with or shorter and broader than the lower) figure 8-shaped or soleæform (*c*). Thecæ 8-spored, ·0024″ long, ·0004″ broad. Paraphyses subdiscrete, united at tips, which are sometimes obscured by brownish-yellow granular colouring-matter. Hymenium blue with iodine. Normal apothecia with a pale flesh-coloured disk. In degenerate apothecia, which are irregularly tuberculiform, and are of the same colour as the thallus, the hymenium has lost its ordinary characters, exhibiting no spores, no blue reaction with iodine, and consisting of an indistinguishable closely aggregated mass of degenerate paraphyses and thecæ; or it has been entirely destroyed or lost, only a hardened horny hypothecium remaining. Thallus generally of pale lemon-yellow colour (as in New-Zealand forms of *calicaris*), generally subcompressed, and terebrate or fenestrate to various degrees—a character which seems common to the New-Zealand *Ramalinæ*. Occasionally its segments are subterete, in which case the plant closely resembles Jersey specimens in my herbarium.

2. Var. *sepiacea*, Pers. (Fig. 21.) In herbarium Kew (sub nom. *R. terebrata*, Tayl., and *R. verrucosa*, Tayl.): Cape Horn, Falkland Islands, and Hermite Island, on granite rocks far from the sea (Dr. Hooker, Antarct. Exped.).

Spores oblong-ellipsoid, 1-septate, colourless, about ·0005″ to ·0006″ long, but variable as to size. Apothecia abundant, scattered especially about the tips of the thalline segments, which are canaliculate and narrow, or broad, flat, and terebrate or fenestrate, sometimes 8–10 inches long.

Genus X. USNEA. (Plate LXI.)

Sp. 1. U. BARBATA, Fr. [Linds. Spermog. 123.]

a. Corticolous. On forest-trees, especially when old, decaying, or dead; Lower bush, Saddle-hill, Otago: W. L. L.: in fruit. On scrub in the forests of Coromandel, province of Auckland; abundant, and in fruit: W. L. L. On species of *Fagus*, where they become dwarfish and disappear, on the mountains of Nelson at an elevation of about 4400 to 4700 feet.

b. Saxicolous. On gneiss, Gabriel's Gully, Tuapeka, Otago: W. L. L.: sterile.

The plant is very rare in fruit; but in the sterile condition it is frequently extremely abundant, "mossing" over trees to such an extent as to give them, at a distance, the aspect of possessing a peculiar light-green foliage. It clothes forest-trees in the same way and to the same extent that it does in Europe. It appears to be as variable in New Zealand as in Britain; and all the British forms are to be seen more or less abundantly throughout New Zealand. None of them are, in my opinion, well defined or deserving of separate rank as named varieties. It appears to me to be sufficient for the purposes of the student or of science, in the case of a plant so infinitely variable, to record in classification the *general directions or forms of its variation.* Not only do I reduce all British forms to a single protean species, but not a few foreign ones are (as in the parallel case of *Ramalina*) capable of reduction, with advantage, to the same cosmopolite type, *U. barbata.*

A. Var. *ceratina*, Ach.

1. On trees, Christie's bush, Saddle-hill, Otago: W. L. L. Fertile and sterile; very variable in its external characters.

Spores broadly oblong-ellipsoid or subspherical, simple, colourless, margined in maturity, about ·0003″ in diameter. Thecæ 8-spored, broadly obovate or saccate above, ·0015″ to ·0018″ long, ·0006″ to ·0009″ broad. Both thecæ and spores are larger and more distinct than in New-Zealand specimens of var. *florida*; otherwise the characters of the hymenium are identical. The apothecia are sometimes brown-maculated with a parasite* (*Phymatopsis dubia*, Linds.), which also occurs, alike in European and New-Zealand specimens, on the thallus and cephalodia (figs. 29–32). In other cases the epithecium is eroded in patches, exposing the yellow hypothecium. The colour of the apothecia is frequently a pale flesh-tint, or a brownish yellow. The margin is fringed with numerous branch-like, filiform, divergent cilia or fibres. Fructiferous specimens have a thallus combining sometimes the characters of those of vars. *plicata* and *florida*; the thalline segments are frequently filiform, very slender, and much entangled. Sterile specimens vary in other directions. Generally the aspect is waxy, and sometimes the colour pale lemon-yellow. Occasionally there are brownish-red discolorations about the bases of the main branches. In some cases the branchlets are roughened with very minute soredia and isidiiform tubercles; in others, the cortical layer has been eroded annularly here and there, constituting the condition called by authors *articulata*, the central white medullary thread being exposed. In articulate forms there is generally no inflation of the so-called joints; but sometimes, in the larger or main branches, there are slight constrictions, where annular decortication has taken place.

2. On twigs of trees, Auckland: Dr. Sinclair. Abundant in fruit and spermogones, the latter occurring, towards the tips of certain branchlets (which are black like those of *Neuropogon melaxanthus*), as isolated or scattered distinct tubercles. The ordinary-coloured branchlets are sterile as to spermogones. The plant has the characters of var. *hirta*.

3. In herbarium Kew. On old trees, mostly Mangroves. North Island (Dr. Joliffe).

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* Obs. Otago Lich. and Fungi, p. 442, plate xxx. figs. 36–42.

associated with var. *florida*: sterile, sorediiferous, of a reddish colour, partly referable to var. *plicata*, partly to *florida*. Fig. 23: Jamaica (Wilson): spores oval, ·00025″ long, ·00020″ broad.

4. Fig. 22: Rio Janeiro (Henry Paul, 1846). Spores (*b*, *c*) slightly variable as to size, form, and colour: oval-oblong, oval, or subspherical; simple, margined in maturity; sometimes pale yellow (endospore), more generally colourless. Thecæ (*a*, *e*) also somewhat variable as to size, short and subsaccate, deep blue with iodine (*e*).

B. Var. *florida*, L. (Fig. 24.)

On trees in the bush, Pelichet Bay, Dunedin, Otago: W. L. L.: fruit abundant. Spores (*b*, *c*, *d*) oblong-ellipsoid or subspherical, simple, colourless, ·0003″ long, ·0002″ broad. Thecæ (*a*) 8-spored, ·0012″ to ·0015″ long, ·00045″ broad. Paraphyses closely aggregated. Hymenium blue with iodine; constituents somewhat indistinct. Thallus dwarfish, 1–1½ inch tall, with articulate branches. This annular decortication, indeed, is, like many other characters on which separately named varieties have been founded, common to all forms or conditions of *U. barbata*, though it is more marked in some of the larger and terricolous forms. Hence a var. *articulata* is not only unnatural and incorrect, but mischievous in classification, just as vars. *ceratina*, *hirta*, *florida*, and *plicata* are. These represent simply conditions which are not unfrequently combined in some individual plant; in which case the unfortunate student is utterly puzzled to what variety to refer it, partaking, as it does, of the characters of two or more varieties.

In herbarium Hooker: on old trees, chiefly Mangroves, North Island (Dr. Joliffe, 1852): sterile. Other North-Island specimens are fertile, with an ochroleucous thallus, oval or subspherical spores, and small obovate thecæ, blue with iodine. Fig. 25: Tasmania (Dr. Hooker, Antarct. Exped.). Spores (*d*, *e*) oblong-ellipsoid, longer, though not broader, than in Tasmanian forms of var. *hirta*. Thecæ (*b*) blue with iodine, longer and narrower than in Tasmanian forms of var. *hirta*. In the latter, collected by Lawrence, the spores (fig. 44) are subspherical and small, and the thecæ blue with iodine, short, and broad.

C. Var. *articulata*, Fr.

On trees, Saddle-hill bush: sterile. This appears to be merely a condition of *florida*, with annular decortication. The joints or articulations are not inflated; the thalline segments are narrow, filiform, and very smooth; the plant possesses the waxy aspect and the delicate lemon-yellow hue so common in *U. barbata* in warm countries, with patches, here and there, of ochraceous discoloration.

D. Var. *plicata*, Fr.

On trees in the forests of Mount Cargill, Dunedin, Otago: W. L. L.: very abundant. In herbarium Kew: Waiheki, North Island, on stones and trees, frequent (Milne, H.M.S. 'Herald,' 1854). Agrees apparently with *U. trichodea*, Nyl., which seems only an exaggerated form, peculiar to warm countries, the filaments being very long, delicate, and much entangled. Specimens from Norfolk Island, St. Domingo, &c., have a similar character. *U. angulata*, Ach., Hook. fil. and Tayl., from Ceylon (fig. 26), seems to me referable to *U. longissima*, Ach. (fig. 40), which again is referable to *U.*

barbata: at least I know of no essential distinction between them. The branches are long, plicate, slender, with long, delicate cross fibres, as in *florida*. The apothecia are very large, but the spores very small, ·0002″ long, ·00016″ broad, oval or subspherical; thecæ ·0010″ to ·0013″ long.

Throughout all the *Usneæ* I have examined, from every part of the world, there is great general uniformity as to the characters of the apothecia and spermogones, spores and spermatia. The variations of the thallus, however, are infinite, and set at defiance all efforts of the systematist to limit and define their species and varieties. I have no doubt the present number of book species and varieties is unnecessarily and improperly numerous, being capable of reduction, with advantage, to one or two great types, such as *U. barbata*.

Genus XI. NEUROPOGON, Nees and Flot. (Plate LXI.)

Sp. 1. N. MELAXANTHUS, Ach. (Fig. 28.) [Linds. Spermog. 125; *Usnea*, Bab. L. N. Z.]

Dun Mountain, Nelson (elevation 3000 feet), in fruit: in herbarium of Dr. Sinclair, at Auckland (Dr. Monro). Probably also from the Alps of Nelson, Hermite Island, Cape Horn, and Falkland Islands (Dr. Hooker, Antarct. Exped.): all in herbarium Kew. Spores (*a*, *e*) oblong-oval, simple, colourless, margined in maturity, somewhat variable as to size, sometimes much intermixed with oil-globules (*e*). Thecæ (*d*) shortish, subsaccate, blue with iodine, 8-spored. Paraphyses (*b*) indistinct; tips pale brown in some specimens, in others deep indigo-blue—a colour which, in the same specimens, pervades the hymenium (*b*, *c*). The spores are those of *Usnea barbata*: the plant has the general aspect of an *Usnea*; and I am not convinced of the propriety or necessity of dissociating it from that genus. It is a stout, shrubby, handsome plant, whose peculiar aspect is due to its arctic and antarctic distribution.

Var. *ciliatus*, Nyl. L. N. Z. 245. (Fig. 27.)

Tarndale, Nelson Dr. (Sinclair): in my herbarium. Spores (*a*, *b*, *c*) frequently subspherical, somewhat irregular in form (*a*), ·0003″ long, ·0002″ broad; in general characters they correspond with those of the type and with those of *Usnea barbata*, as do also the thecæ and other constituents of the hymenium. Spermogones very plentiful. seated on or in the thickened black tips of the ramuscles and apothecial cilia. Spermatia (*d*, *e*) straight rods, generally about ·0003″ long, and ·00005″ to ·00007″ broad. variable, however, as to length, sometimes only half-length (*e*), as if they had been divided, like 1-septate spores, into two. Sterigmata short, about ·0006″ long, apparently subsimple. I cannot see in what respect this variety differs from the type, as it occurs in a series of antarctic specimens in my herbarium; the apothecia and spermogones are the same; yet Nylander says it is perhaps a distinct species. The black spermogoniferous tips of the ramuscles and apothecial cilia, hitherto supposed to be characteristic of *N. melaxanthus*, occur occasionally in southern and antarctic forms of *U. barbata* (*e.g.* Auckland New-Zealand specimens of var. *ceratina*, the form which, moreover, in general aspect most nearly approaches *N. melaxanthus*).

Genus XII. THAMNOLIA.

Sp. 1. T. VERMICULARIS, Ach.

Tarndale, Nelson (Dr. Sinclair): in my herbarium: sterile, but bearing traces of the parasitic *Microthelia vermicularia*, Linds. (Spermog. 143, plate v. figs. 19, 24, 25, and Obs. Otago Lich. and Fungi, p. 441). The plant differs in no respect from Scotch alpine specimens in my herbarium (from Lochnagar and Ben Lawers).

In Dr. Sinclair's herbarium, at Auckland, I found specimens both of the type and its form or var. *taurica*, Ach., from the Dun Mountain, Nelson—as usual, not in fruit. The apothecia are extremely rare, if they have ever been really found. Massalongo, however, describes them (in 'Flora,' 1856, p. 234); and Mudd (June 1865) informed me of his having also discovered them*.

Genus XIII. STEREOCAULON. (Plate LXII.)

Sp 1. S. RAMULOSUM, Ach. pr. p., Nyl. (Fig. 1.) [Linds. Spermog. 153, plate vi. figs. 27–32.]

In crevices of the basalt, Greenisland Bluff: spermogoniferous.

Specimens in my herbarium from Tasmania (fig. 1) and New Zealand, collected by Dr. Hooker during the Antarctic Expedition, are identical, apparently, with the Otago plant. Spores (*d*, *e*) sublinear or narrowly fusiform, 3-septate. Thecæ (*b*) shortish, 8-spored, blue with iodine. Paraphyses (*a*) discrete, with pale-brown, distinctly knobbed heads. Podetia studded over with cephalodia, which resemble large, pale, shrivelled abortive apothecia, sometimes terminal on the lateral branchlets; their structure, which is that of the thallus, at once demonstrates their true character.

In my herbarium is a suite of specimens, labelled *S. argus*, Tayl., from Campbell's Island (Dr. Hooker, Antarct. Exped.), sent me by Dr. Hooker in 1856. Microscopic examination enabled me at once to divide them into two groups:—the one possessing very large muriform spores, like those of *Umbilicaria pustulata* or *Lecanora chrysosticta*, and 1-spored thecæ, referable to what Th. M. Fries has subsequently described as a separate genus and species, *Argopsis megalospora* †; the other having the spores and thecæ of *Stereocaulon*, though the former are larger than usual. The latter group is referable either to var. *microcarpum*, Bab. (Nyl. Syn. 236), of *S. ramulosum*, or to the more common forms of that species. Spores (fig. 2) much mixed with oil-globules (*d*), linear-oblong, sometimes broader at one end, colourless, variable as to size, 6-septate, sometimes 3-septate (*e*); in the latter case they are much smaller than when 6-septate, and, indeed, in some cases are evidently half-spores, the result of subdivision after emission from the thecæ. Thecæ 8-spored, largish (*b*). Paraphyses (*a*) discrete, with tuberculated brown tips.

Sp. 2. S. MIXTUM, Nyl.

On trap boulders, south shoulder of Kaikorai Hill, Otago: W. L. L.: spermogoniferous.

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* Compare his 'Monograph of British Cladoniæ' (1865), p. 35.

† "Monographia Stereocaulorum et Pilophororum," Nova Acta Regiæ Societatis Scientiarum Upsaliensis, 3d ser. vol. ii. 1856, pp. 307, with four 4to plates.

Generally 5 to 6 inches long; a somewhat entangled mass of straggling branchlets or podetia; sometimes, on rocks, it is dwarfed, and only about 1 inch high. I fail to distinguish it from *S. ramulosum*; and I would scarce give it place as a separate named variety thereof. In specimens of what appears to be the same lichen, collected in the Chatham Islands by Travers jun., and sent to me by Dr. Müller of Melbourne, the spores and the constituents of the hymenium generally are exactly as in *S. macrocarpoides*, and thus refer both species to *S. ramulosum*.

Sp. 3. S. CORTICATULUM, Nyl.

On tertiary grits and conglomerates, base of Saddle-hill; on mica-slate, Taylor's Creek, Saddle-hill, Otago: W. L. L.: in all cases sterile. The most common of the *Stereocaula* I met with in the Greenisland district of Otago. The plant is dwarfish, about $\frac{1}{8}$ to $\frac{1}{4}$ inch tall, generally subcoralloid, densely tufted, forming a rigid pile covering the stones on which it occurs; comparatively little branched, subsimple and smoothish, or finely branched, subfarinose, of an ashy or pale-greenish grey colour, resembling, as do certain forms of the plant generally, an exaggerated condition of *S. nanum*, Ach.

In some forms the tips of the podetia are crowned with peculiar tufts, resembling the largest densest forms of *S. nanum*—resulting, apparently, from a condition of minute branching and subfarinosity of the terminal divisions of the podetia.

Sp. 4. S. MACROCARPOIDES, Nyl. (Fig. 3.)

"New Zealand," Travers, sent me by Dr. Müller, Melbourne; in fruit, and spermogoniferous. Spores (*c, d*) sublinear or narrowly fusiform, polyseptate, ·0015″ to ·0020″ long, ·00010″ to ·00015″ broad. Spermogones numerous and distinct, as wartlets seated immediately below the apothecia, each pierced by an irregular brown ostiole. Body brown, semitranslucent, immersed. Spermatia (*b*) in myriads, linear, curved (crescent-shaped); straight while attached to the sterigmata, ·0003″ long, ·00005″ broad. Sterigmata short, simple, under ·0003″ long; basal cellular tissue greenish yellow (*b*).

Auckland, Dr. Sinclair, in fruit. Spores (*c, d*) narrowly fusiform, colourless, 3- or polyseptate, straight, ·0009″ long, ·00001″ broad. Thecæ 8-spored, beautiful blue with iodine (as the whole hymenium is), ·0024″ long, ·00045″ broad. Paraphyses discrete and distinct, with large tuberculiform, brownish, loosely aggregated tips (*a*). Apothecia generally terminal, large, and handsome, sometimes ball-shaped, occasionally sublobulate or as if composed of two or more confluent disks, sometimes small; disk or epithecium frequently eroded in patches, as in *Sticta*. This is a fine plant, growing generally in tufts 2–3 inches high; but I cannot distinguish it by any good characters from *S. ramulosum*. Like *Ramalina* and *Usnea*, and not a few others, the genus *Stereocaulon* consists of plants so variable, that it is most difficult to limit or define its species and their varieties. It appears to me that all known species, British and foreign, are capable, with advantage, of reduction to a very few types, whereof the ubiquitous *S. paschale*, Ach., is the principal.

Genus XIV. SPHÆROPHORON. (Plate LXII.)

Sp. 1. S. TENERUM, Laur. (Fig. 4.) [Linds. Spermog. p. 149, plate vi. fig. 53.]

On the bark of decaying or dead trees, Saddle-hill bush, Otago: W. L. L.: sterile. A large, lax, straggling plant, sometimes ½ to 1 foot in diameter. It resembles some of the laxer forms of the common *S. coralloides*, to which, indeed, I refer it. In general aspect it has also some resemblance to various species of *Stereocaulon* and *Cladonia*. Its corticolous habit is somewhat peculiar, as contrasted at least with the general terricolous or saxicolous habit of the northern *Sphærophora*. The same peculiarity pertains to certain of the New-Zealand *Cladoniæ*.

In Auckland-Island specimens (fig. 4) in my herbarium (Dr. Hooker, Antarct. Exped.), in fruit and spermogoniferous, the spores are quite those of *S. coralloides* and *S. compressum*, somewhat variable as to size, covered or associated with a bluish black powder (*b*). The spermatia are very minute, atomic, ellipsoid, borne apparently on compound or articulated sterigmata, which, however, were indistinctly seen. In my Mem. Spermog. (plate vi. figs. 47 & 51) I have figured the sterigmata and spermatia of *S. compressum* and *S. coralloides*—the former as simple, though subramose, the latter as linear. If the foregoing observation in *S. tenerum* is correct, it is distinguished from its co-species by possessing compound or jointed sterigmata, and shorter, ellipsoid spermatia. Nylander (in his Syn. p. 169, plate v. fig. 47) describes and figures the spermatia of the genus *Sphærophoron* as oblong, but those of *S. compressum* he refers to as ellipsoid. Again, those of *S. fragile* he describes as oblong-cylindrical (p. 172, plate v. fig. 45), though they appear of similar form and size to those of *S. compressum*.

Sp. 2. S. COMPRESSUM, Ach. (Figs. 5–7.) [Linds. Spermog. 149.]

Auckland (Dr. Sinclair): in fruit and spermogoniferous (fig. 5), but both apothecia and spermogones for the most part degenerate. Spores spherical, about ·00045″ in diameter, margined in maturity, generally more or less covered and obscured by dark, granular, black or bluish-black colouring-matter; differing in no respect from those of *S. coralloides* and *S. tenerum*. The plant is essentially the British one; which, however, is seldom so handsome as southern and (especially antarctic) forms. In a specimen of *S. compressum* in my herbarium (fig. 7), from Ireland (Miss Hutchins), the spores are colourless (*a*, *c*), which they are in the young (and sometimes also in the old) state in all species of *Sphærophoron*. They are spherical, frequently about ·0002″ in diameter, but variable both as to size and form, often presenting in age irregularities in outline (*b*), resembling those produced in blood-corpuscles by exosmotic and endosmotic changes. In herbarium Kew (Auckland —Colenso and Dr. Joliffe, 1853) are some sterile specimens: thallus much deformed, and covered with isidiiform and subfoliaceous growths.

Var. *Australe*, Laur. [*Sphærophoron Australe*, Bab., L. N. Z. p. 40, plate cxxx. C; Linds. Spermog. 151.]

North Island, New Zealand (Colenso); Cape Horn, Falkland Islands, Campbell's Island (Dr. Hooker, Antarctic Expedition); Port Famine (King); Tasmania (Fraser and Gunn); New Holland (Sieber): all in herbarium Kew; the antarctic series also in my herbarium: partly sterile, partly in fruit and spermogoniferous. An authentic specimen of Laurer's plant, from Professor Churchill Babington, in herbarium Kew, bears the annotation, apparently by Babington, "No doubt this is your *S. compressum*." It appears to me impossible to separate *Australe* from *compressum*, perhaps even as a variety specially named. True, antarctic specimens differ much from our ordinary British plant, in being much handsomer and larger in all dimensions; but if the passage-forms are watched for and examined, it will be found that the gradations are numerous and imperceptible; and the same doubt will occur (as in the genera *Ramalina*, *Usnea*, *Stereocaulon*, and others) whether all the British and foreign species yet known may not be properly reducible to one or more widely diffused and variable types, such as the common *S. coralloides*. Intermediate between the British *S. compressum* and the antarctic *S. Australe* is a series of South American forms in herbarium Kew. The divisions of the thallus are generally broad, of a waxy aspect, and pale grey above, buff below, frequently channelled or concave below and convex above; sometimes they are very narrow and sublinear. In some cases the fructiferous ramules are deformed and scarcely recognizable; in Tasmanian specimens, the apothecia are sometimes seated in the axils of divergent spermogoniferous ramules. Some specimens are largely spermogoniferous, the spermogones occupying their usual position in *S. compressum*—the ends, angles, and prominences of the ramules. Tasmanian specimens do not differ from New-Zealand ones; but both are inferior in size and beauty to, though they are essentially identical with, antarctic forms.

Genus XV. BÆOMYCES. (Plate LXII.)

Sp. 1. B. FUNGOIDES, Ach. (Fig. 8.)

On the ground, Tarndale, Nelson (Dr. Sinclair): in my herbarium, in fruit. A beautiful little species. Spores (*b*) fusiform, simple, colourless, ·00045″ long, ·00010″ to ·00015″ broad. Thecæ (*a*) very distinct, 8-spored, ribbon-shaped, ·0030″ long, ·00028″ broad. Paraphyses subdiscrete, without clavate heads. Hymenium pale blue with iodine.

In herbarium Kew there are specimens from Dr. Swartz (probably from Germany), 1805, having similar characters. Spores ·0003″ long, ·0001″ broad. Thecæ blue with iodine, ·0023″ long, ·0003″ broad. The plant is larger and stouter than *B. roseus*; but otherwise its characters are the same. The stem is simple, generally bearing only one terminal apothecium; sometimes it branches above, each branch then bearing at its apex an apothecium. Both New-Zealand and German specimens appear to me to be inseparable from *B. roseus*, Pers., which occurs in herbarium Kew from the north island of New Zealand: on dry hills (Dr. Joliffe). In the same herbarium, *B. rufus*, DC. occurs, from the North Island (Colenso).

Genus XVI. CLADONIA. (Plate LXII.)

Sp. 1. C. AGGREGATA, Eschw. [Linds. Spermog. 170.]

Known to the older lichenologists as *Dufourea collodes*, Tayl.; but it has all the characters of a *Cladonia* near *rangiferina* and *furcata*, to which it is closely allied by its apothecia and spermogones.

On ground about the base of Saddle-hill: in the bush, Manuka Gully, Saddle-hill; on trunks of dead trees, East Taeri bush, Otago: W. L. L.: partly in fruit and spermogoniferous, partly sterile. Thecæ ·0009″ to ·0012″ long, ·0003″ to 00045″ broad; very faint blue with iodine. Spores not distinctly seen. Hymenial constituents generally indistinct. Paraphyses closely aggregated, with granular brownish tips.

Like many other *Cladoniæ*, the plant is extremely variable, especially as to colour and size and the denseness or laxness of the thalline branches. Sometimes it is a dwarf, corresponding to form or condition *pumila* of *C. rangiferina.* Nylander apparently (on my specimens) regards this as a young state simply; but it appears to me as permanent a condition of growth as similar states of *C. rangiferina.* In this condition the plant is spermogoniferous, but not in fruit; the branches are narrow, slender, and much entangled. More generally the plant is handsome, fully fruiting, and from 2 to 6 inches tall: on the ground it generally grows more lax than on trees; but in all habitats it may be slender and elongated, or turgid, stoutish, and dwarf; and the podetia may be smoothish, though the general tendency is to fossulation or pertusion. In some forms (which systematists would be quite justified, according to the present principles and practice of classification and nomenclature, to denominate variety or form *pertusa*), the brown podetia are marked by a more or less closely aggregated series of ellipsoid or elongated apertures, through which their white farinose inner surface is prominently and beautifully visible. This same fenestration is more fully and beautifully developed in the closely allied *C. retipora*, Flk., which also occurs in New Zealand (Auckland, Dr. Sinclair, in my herbarium; Linds. Spermog. 170). These two black-fruited species further agree in being peculiar to the southern hemisphere, and in being comparatively well-marked plants. In herbarium Kew, *C. aggregata*, from the Falkland Islands (fig. 9) (Dr. Hooker, Antarctic Expedition; and Edmonston), is associated with, and mistaken for, *Cetraria aculeata*, Fr., a plant to which it certainly bears, especially as regards its colour and general habit or aspect, a great resemblance.

In a specimen from Tasmania (Antarctic Expedition, Dr. Hooker) the spores are simple and ellipsoid (as is their general character throughout the *Cladoniæ*), though minute and with difficulty seen (equally characteristic of the spores of *Cladonia*). The thecæ become blue with iodine; paraphyses and thecæ short and, like the spores, indistinct.

Sp. 2. C. RANGIFERINA, Hffm. [Linds. Spermog. 168.]

Form *pumila*, Ach. On trunks of dead trees, Saddle-hill bush, Otago: W. L. L.: sterile. Small in all its parts; branchlets much entangled; resembles the British var. *alpestris*, Sch. Its habitat, however, differs from that of the British plant, which is never, so far as I am aware, corticolous. Spermogoniferous specimens, labelled "New Zealand," from Dr. Müller, Melbourne, occur in herbarium Kew, referable either to *C. rangiferina* or *C. pycnoclada*. *C. rangifera* is infinitely variable as to size, colour, the degree of branching, and the density of aggregation of the branchlets. It is impossible to define or limit properly its inconstant varieties; and I think, therefore, it is unnecessary and mischievous to separately name such mere conditions as *sylvatica*, Hffm., and *alpestris*, Schær.

Sp. 3. C. PYCNOCLADA, Pers. [Nyl. L. N. Z. 244.]

On ground in the bush, Manuka Gully, Saddle-hill, Otago: W. L. L. Associated with *C. aggregata*; abundantly spermogoniferous, the spermogones being identical with those of *C. rangiferina*.

I cannot distinguish it by any sufficient characters from the condition of *C. rangiferina* called *alpestris*; it possesses the same beautiful pure lemon-yellow colour, passing into an ash-grey. It is probably, in whole or in part, the *alpestris* of Bab. L. N. Z.

Auckland specimens in herbarium of Dr. Sinclair quite agree with the Otago plant, except that the former are generally slightly taller, straighter, more rigid, and handsomer. In his Syn. 212, Nylander considers *C. pycnoclada* a mere var. of *C. rangiferina*; but in L. N. Z. 244 *, he dissociates it as a separate species. I still refer it to *C. rangiferina*, but hesitate as to its deserving separate place and name as a variety. Large patches of forms of *C. rangiferina* from Tasmania and Jamaica are exhibited in the Museum of Economic Botany, Kew.

Sp. 4. C. DEGENERANS, Flk. (Fig. 10.) [Linds. Spermog. 157.]

Type: on ground, base of Saddle-hill. In fruit and spermogoniferous.

Form *euphorea*, Ach. On rotten trunks of trees, East Taeri bush. Apothecia abundant. Associated with *C. aggregata*, also in plentiful fruit: varies in height from ½ to 3 inches; larger forms very handsome.

Form *aplotea*, Ach. On trunks of dead trees, East Taeri bush. Fruit abundant.

Form *lepidota*, Ach. On ground, base of Saddle-hill, in fruit; on trunks of dead trees, East Taeri bush, in fruit and spermogoniferous.

The spores, and in general the constituents of the hymenium, are the same in the type and all its forms above mentioned. Spores (fig. 10) narrowly ellipsoid, straight, sometimes slightly curved or plano-convex, simple, colourless, ·00045″ long, ·00020″ broad. Hymenium deep blue with iodine; its constituents as indistinct as in the majority of the *Cladoniæ*.

Form *erratica*. On limestone, Woodburn, Saddle-hill: W. L. L.: spermogoniferous, but without apothecia. The horizontal thallus becomes curled up into ball-like masses, which are detached in course of time from the ground, and which then roll freely before the wind on the downs about the seaward base of Saddle-hill. The plant has considerable resemblance to saxicolous congesto-laciniate forms of *Physcia stellaris*. The curling up of the thallus, its gradual assumption of a ball-shape, and its ultimate detachment from its basis of support (which is generally the ground) I have occasionally met with in other lichens, especially in a form of *Parmelia lævigata*, sent me by Sir Walter Trevelyan in 1857 (Mem. Spermog. 218). *Lecanora esculenta*, Evers., seems to be an erratic lichen of the same character; and I have found ball-shaped deformed portions of the thallus, though not detached, frequently in *L. tartarea*, Ach., and *L. ventosa*, Ach.

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* In a letter, January 26, 1866, he writes :—“ La forme de *Cladonia* appelée *pycnoclada* me parut alors presque une espèce distincte. Depuis j’en ai vu, même de la N$^{\text{lle}}$ Calédonie, qui montre un passage au *Cl. rangiferina*.”

On the Greenisland coast, Otago, small balls of zoophytes* are very common, which are evidently so far the produce of, and roll freely before, the wind, just as do the spherical masses of the forms *erratica* of *C. degenerans* and *P. lævigata*, above alluded to.

Sp. 5. C. FIMBRIATA, Hffm. [Linds. Spermog. 156.]

On trunks of dead trees, East Taeri bush, Otago: W. L. L.: sterile. North Island (Dr. Joliffe): in herbarium Kew: on ground, sterile.

Var. *cornuta*, Nyl., Mercury Bay (Dr. Joliffe, 1852), on moist ground, and other North-Island specimens in herbarium Kew, are (at least partly) referable to the *cornuta* form of *C. gracilis*.

Var. *radiata*, Nyl. On dry hills, North Island (Dr. Joliffe), in fruit, in herbarium Kew, is referable, I think, to *C. pyxidata*, from which, indeed, I do not think *C. fimbriata* can be properly dissociated as a species.

C. pyxidata, L. [Linds. Spermog. 155], occurs in my Dunedin herbarium: sterile; on ground about base of Saddle-hill: quite the common British plant.

Sp. 6. C. AMAUROCRŒA, Sch. [Linds. Spermog. 166, plate vii. f. 32–4.]

Var. *capitellata*, Bab. [L. N. Z. 32, plate cxxx. B; Linds. Spermog. 166, plate vii. fig. 32; sub nom. *Cenomyce capillata*, Tayl., in 'London Journal of Botany:' specific name by misprint probably.]

North-Island specimens, in herbarium Kew, from Colenso, have greatly the characters of certain forms of *C. furcata*, possessing, however, the beautiful colour of *C. amaurocræa*, with sometimes a bluish tint at the bottom of the older podetia. The plant is of somewhat lax habit; the podetia straight, simple, or not much branched; cortical layer sometimes eroded in patches, exposing the brown medullary tissue, giving a brown-mottled character to the podetia; old apothecia sometimes perforate.

The Hookerian herbarium, Kew, contains also the three following New-Zealand *Cladoniæ*:—

Sp. 7. C. FURCATA, Hffm. [Linds. Spermog. 166.]

North Island (Colenso and Joliffe): spermogoniferous. A very delicate form, with very white, minutely scale-covered podetia.

Sp. 8. C. SQUAMOSA, Fr. [Linds. Spermog. 159.]

Mangrove River, Mercury Bay, on dry hills (Dr. Joliffe, 1852): in fruit and spermogoniferous.

Sp. 9. C. GRACILIS, Fr., var. *verticillata*, Sch. [Linds. Spermog. 159.]

North Island (Dr. Hooker, Antarctic Expedition). Associated with *C. aggregata*.

Var. *cervicornis*, Ach. North Island (Dr. Hooker, Antarctic Expedition): in fruit, which is quite that of *C. pyxidata*.

Sp. 10. C. MACILENTA, Hffm. [*C. filiformis*, Relh., Linds. Spermog. 163.]

On mud, Oha Creek, Kaipara (Mossman). Occurs in the University of Edinburgh herbarium, in fruit.

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* Dr. M'Intosh tells me these consist of species of *Laomedea*, and that similar masses of similar constitution, but of greater size, are to be found on the east coast of Scotland (*e. g.* St. Andrews).

Genus XVII. Pannaria. (Plate LXII.)

Sp. 1. P. leucosticta, Tuck. (Fig. 11.) [Nyl. L. N. Z. 250.]

In crevices of mica-slate, Glen Martin, Chain-hills, in fruit, associated with *Verrucaria pallida*, Ach.; on boulders of tertiary quartzose grit, base of Saddle-hill, Otago, in fruit: W. L. L.

Spores ellipsoid, simple, colourless, ·0006″ long, ·00025″ broad. Thecæ 8-spored, ·0030″ long, ·0006″ broad. Paraphyses subdiscrete, with slightly brown, tuberculiform heads. Hymenium pale blue, sometimes wine-red, with iodine. Apothecia sometimes sunk in the squamulose thallus, sometimes sessile and prominent, generally with a convex or turgid disk. Thallus varying in colour from grey to lurid; in the former case the apothecia are distinct, in the latter obscure. The plant has a general resemblance to *P. brunnea*, Sw.

Sp. 2. P. nigra, Huds. [Nyl. L. N. Z. 250.]

On tertiary "Crag" (made up of fragments of *Ostrea*, &c.), Woodburn, Saddle-hill, Otago: W. L. L.: in fruit. Spores indistinct. Paraphyses with dark-brown, granular, closely-aggregated tips. Hymenium deep blue, constituents indistinct. The plant appears identical with Irish specimens in my herbarium (Carroll), very common on limestone in the Cork district, in fruit. Here also the spores are very indistinct, ellipsoid, varying from simple to 3-septate.

Genus XVIII. Coccocarpia.

Sp. 1. C. molybdæa, Pers. [Linds. Spermog. 258.]

North Island, Colenso; sub nom. *C. smaragdula*, Pers. and Bab. L. N. Z. This is probably one of a few *North*-Island species which can hardly be looked for in the *South* Island, inasmuch as it is essentially a plant of warm or tropical countries, in which, however, it is common and widely diffused. In herbarium Kew there are specimens from Carissi (Lich. Amazonici, Spruce and Bab.), with confluent maculiform apothecia, exactly like those of the British *C. plumbea*, to which, indeed, *C. molybdæa* has, at the least, a striking general resemblance.

Genus XIX. Psoroma. (Plate LXII.)

Sp. 1. P. sphinctrinum, Mont. (Figs. 12–14.)

Otago (Martin): in my herbarium: corticolous (on trees and shrubs). Auckland Islands (Dr. Hooker, Antarctic Expedition): on twigs, associated with forms (*plicata*) of *Usnea barbata*, Fr. All in fruit.

Spores (fig. 12) oval or ellipsoid, broadly margined in maturity, simple; endospore pale yellow. Thecæ 8-spored (*a*, *b*, *c*), linear or saccate according as the spores are arranged in one or two rows. The protoplasm (from which the spores are developed) contains a considerable quantity of oil-globules; thecal lichenine (*a*, *c*) blue with iodine. Paraphyses subdiscrete, very delicate, scarcely coloured at the apex.

Genus XX. PLACODIUM.

Sp. 1. P. MURORUM, DC., var. *miniatum*, Hffm. [Linds. Spermog. 266, plate xv. figs. 1, 2.]

On slaty trap, Shaw's Bay, the Nuggets, and Kapuwaka Creek, Finegand Station, Lower Clutha. Common on talc-slate, Otokia Bluff, Otago: abundant also on the trachytic rocks which form the banks of the Pukaki lake, North Shore, near the town of Auckland, as well as on the trachytic and other rocks which constitute the basis or bulk of Beeson's Island, Coromandel Harbour, Auckland: W. L. L.

Genus XXI. PLACOPSIS, Nyl.

Sp. I. P. GELIDA, L. [Linds. Spermog. 261.]

On basaltic rocks and boulders, Kaikorai Hill; Signal-hill, N.E. valley, Dunedin. On basaltic porphyry, Forbury Head, Dunedin. On basaltic rocks in the gullies of the Greenisland hills. On slaty trap and trap conglomerates, Ferry Bluff, Clutha ferry: apparently partial to basaltic rocks and stones, on which it is more or less common, and frequently in fruit, throughout the Greenisland and Saddle-hill district of Otago: W. L. L. Often associated and apt to be confounded with *P. perrugosa*, Nyl. (L. N. Z. 250; Linds. Obs. Otago Lich. and Fungi, p. 415, plate xxix. fig. 17), with which it is at least closely allied.

Apothecia large and very irregular in form, frequently with a wavy or plicate outline or surface. Thallus granulose or subpulverulent, the granules or isidia sometimes overgrowing the apothecia; sometimes tartareous, thick and whitish, approaching *Lecanora tartarea* or *L. parella*; sometimes assuming a pale yellow tint.

In herbarium Kew occur North-Island specimens (Colenso, no. 4740), on water-worn pebbles, sterile: which are identical apparently with the same species, gathered by myself on the banks of the Caledonian Canal.

Placopsis is the latest secession from *Squamaria* or *Lecanora*, as *Parmeliopsis* is from *Parmelia*. I cannot agree with Nylander as to the necessity for such dissociation, preferring to regard them as groups of an old genus rather than themselves the types of new genera. The passage genera between *Parmelia* and *Lecanora* appear to me to be unnecessarily numerous (especially *Pyxine*, *Psoroma*, *Pannaria*, *Coccocarpia*, *Amphiloma*, *Squamaria*, *Placodium*, *Placopsis*, which, I think, might be reduced, and united, with great advantage to classification).

P. gelida is one of many lichens recorded in Fl. N. Z. as a *North*-Island species only, simply because, at the date of its publication (1855), the lichens of the *South* Island had not been (at least to the same extent) collected and examined.* New-Zealand specimens generally agree in aspect and character with those of Highland (Scotch) representatives of the same species.

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* Compare remarks under head *Verrucaria*.

Genus XXII. Squamaria. (Plate LXII.)

Sp. 1. S, GALACTINA, Ach. (Figs. 15, 16.) And var. *dispersa*, Pers.

On porphyritic basalt, Forbury Head; on basalt, south peak of Saddle-hill, Otago: W. L. L.: associated with *Lecanora pyracea* and *L. vitellina*. Apparently *a*thalline; apothecia frequently irregular in outline and size; disk waxy, pale buff to dark slate-colour; margin thick or thin, entire or crenulate—in the latter condition, especially, resembling crenulate forms of *Lecanora umbrina* (*Lichen crenulatus*, Dicks., non Pers., Nyl. L. Scand. 162).

Spores ellipsoid or oblong-ellipsoid, simple, colourless, ·0003″ long, ·00025″ broad. Thecæ 8-spored, ·0020″ to ·0024″ long, ·0006″ broad. Paraphyses indistinct; tips closely aggregated, obscured by granular, brownish, or brownish-yellow colouring-matter. Hymenium blue with iodine; constituents somewhat indistinct.

Genus XXIII. Lecanora. (Plate LXII.)

Sp. 1. L. CHRYSOSTICTA, Tayl. (Fig. 17.) [Nyl. L. N. Z. 252.]

On trees, East Taeri bush, abundantly in fruit; on branches and twigs of living trees and shrubs, Stoney-hill bush, Otago: W. L. L. A beautiful plant, one of the finest *Lecanoræ* of New Zealand.

Spores (*c*, *d*) oblong-ellipsoid, colourless or pale yellow, muriform or granular. ·0030″ to ·0045″ long, ·0009″ to ·0015″ broad. Thecæ (*a*, *b*) 1-spored, deep blue with iodine, especially at their apex, ·0045″ long, ·0012″ broad. Apothecia in normal condition, with a flat (sometimes suburceolate) disk, of an orange-red tint, liable to become difform with age, disk falling away, and leaving the whitish hypothecium, which is concolorous with the thallus. The thallus is one of those subtartareous ones likely to occur variolarioid. The plant generally resembles various forms of *Lecanora parella*, *tartarea*, and *subfusca*, from which, however, it is distinguished by the character of its spores. It is obviously the same plant which is figured by Massalongo as *Myxodictyon chrysosticta* (Lich. N. Z.* plate i.; *Lecanora*, Tayl. Lich. Antarct. 50; *Parmelia*, Bab. L. N. Z. 29). The thecæ are represented as large and 1-spored; the spores as large, muriform in the mature, and simple in the young, state.

Sp. 2. L. PUNICEA, Ach. (Figs. 18, 19.)

On trunks of living trees, and on dead trunks of "Goai," Greenisland bush, Otago: W. L. L. Apothecia somewhat resembling those of *L. rubra*, Ach., save that the disk in *L. punicea* is generally flat or convex. Spores (*a*, *b*) variable as to form and size, colourless, ·0012″ long, ·00015″ broad, fusiform, straight or slightly curved (in one or opposite directions, and in the latter case subvermiform), frequently broader at one end, sometimes finely tapered off at one or both ends, polyseptate (generally 5–10 septa); loculi varying greatly in size, the central generally the larger; sometimes with constriction of the epispore, opposite the central septa especially. Hymenium very deep blue with iodine; constituents very indistinct. Paraphyses-tips obscured by granular, brownish-red colouring-matter. It seems to be the same plant which is figured and described by Massalongo as *Hæmatomma Babingtonii* (Lich. N. Z. plate ii.; *Parmelia punicea*, Bab. L. N. Z. p. 28, "excl. syn. pr. max. parte," says Mass.), corticolous (on trees) in the North Island. The thecæ are represented as 8-spored, the spores as very variable in size, fusiform, 1–20-septate, sometimes curved in the same or opposite directions.

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* 'Sopra tre Licheni della Nuova Zelandia,' by Dr. A. B. Massalongo, with three beautiful coloured plates (Bull. de la Société Impériale des Naturalistes de Moscou, 1863, vol. xxxvi. p. 254).

In herbarium Kew (fig. 19): on tree-barks, Java, Lobb. (sub nom. *L. pulcherrima*, Tayl.); on bark of trees, St. Vincent and Mauritius; on bark, Lachen, Sikkim, Himalayas, reg. temp. 12,000 feet (Dr. Hooker). Essentially a plant of tropical and subtropical countries, in which it is widely distributed; but occurring also at the Cape and in Australia. Some forms have a striking resemblance to *L. hæmatomma*, Ach., to which the plant is at least closely allied. The Sikkim specimen bears the following annotation by Nylander: "Anne potius *L. hæmatomma ecrustacea*?" It is, however, now (and justly, I think) regarded as a separate species. In Java specimens, the disk of the apothecium is of a beautiful vermilion-red, surrounded by a white, mealy, thick, corrugated border. Apothecia sessile, on a rugose, tartareous thallus resembling that of *L. parella*, the thalline surface sometimes rising to a level with the apothecia, as in *L. hæmatomma*. Spores (fig. 19) fusiform, slightly curved, containing twelve or more loculi: frequently, in the young state, when the spore is narrow and the loculi roundish, it has a moniliform character, ·0013″ to ·0016″ long, ·0002″ broad. Thecæ blue with iodine. Paraphyses-tips obscured by the red pigment of the epithecium.

Sp. 3. L. AURANTIACA, Ach., and var. *erythrella*, Ach. (Fig. 20.)

Saxicolous: on columnar basalt, Greenisland Bluff; on basaltic boulders, Forbury Head; on greensand, Woodburn Ravine, Saddle-hill, Otago: W. L. L.: all in abundant fruit. The Woodburn specimens are apparently *a*thalline, or nearly so; those affecting basalt are indistinguishable from Scotch forms as they occur, for instance, on amygdaloid and other trap-rocks on Kinnoull Hill, Perth. Sometimes the fruit is crowded and the apothecia irregularly angular from mutual pressure.

Spores (fig. 20) generally ellipsoid, sometimes subspherical in the young state, variable as to size and form, normally polari-bilocular, the loculi connected or not by a central septum or line which does not appear to be tubular; sometimes the loculi are nuclear, and not seated at the poles or extremities of the spore; or there may be in the young state a single central round nucleus: length ·0003″ to ·00045″, breadth ·0002″ to ·0003″. Generally the spores are smaller in var. *erythrella* (which is essentially a saxicolous form) than in the type. Thecæ ·0024″ to ·0030″ long, ·0006″ broad. Hymenium beautiful blue with iodine.

Similar forms occur in herbarium Kew, from Juan Fernandez (on rocks), and from Wales (Turner, 1792), the latter being var. *ochracea*, Sch., Nyl. (sub nom. *Lichen erythrellus*, Ach.). Spores oval, ·0003″ long, ·00025″ broad.

Some forms of *L. aurantiaca* are apt to be confounded with *L. ferruginea*, Huds., which also occurs in New Zealand, and, as at home, frequently, if not generally, on basaltic or trappean rocks (on basaltic blocks, Signal-hill, North-east Valley, Dunedin, Otago: W. L. L.).

Sp. 4. L. VITELLINA, Ach. (Fig. 21.)

Saxicolous: on basaltic boulders, top of Kaikorai Hill; on basalt, south peak of Saddle-hill; on trachytic rocks, coast-cliffs, Anderson's Bay, Dunedin, Otago: W. L. L. In fruit, more or less common, associated with *Parmelia conspersa*, various forms of *Lecidea parasema*, and other saxicolous lichens common on basaltic and trappean rocks. Indistinguishable from the British plant.

Spores (fig. 21), oblong, straight, or slightly curved, as in *Ramalina*; simple, or faintly 1-septate, colourless, ·0003″ long, ·00015″ broad. Thecæ polysporous, ventricose or saccate, ·0018″ to ·0024″ long, ·0006″ to ·0009″ broad. Hymenium beautiful blue with iodine. The parasitic *Lecidea vitellinaria*, Nyl., so common on its thallus in Britain, may be looked for in New Zealand; for the presence of *Abrothallus* in the latter shows that there is every reason to expect the same parasitic lichens in the southern as in the northern hemisphere (where the species themselves occur whose apothecia or thallus form their habitat). The black apothecia, prominent on the beautiful greenish-yellow thallus, will at once indicate the alien *Lecidea* where it occurs. This so-called species, however (*L. vitellinaria*), I regard simply as an *a*thalline and possibly sometimes parasitic form of the common *Lecidea parasema*, which, especially in New Zealand, is not only more generally saxicolous than corticolous, but which is one of the most frequent companions of *L. vitellina*.

Sp. 5. L. PYRACEA, Ach. (Fig. 22.)

On basalt, south peak of Saddle-hill, Otago: W. L. L. A beautiful little species, with inconspicuous thallus and minute much crowded apothecia, resembling the small saxicolous forms of *L. aurantiaca*, var. *erythrella*, to which, indeed, I refer the plant. Externally and internally the apothecia are essentially the same (the colour only differing somewhat), and I fail to discover any sufficient distinction between *pyracea* and *erythrella*. It seems to me, moreover, that *ferruginea* and *aurantiaca* may be united with advantage.

Spores (fig. 22) broadly ellipsoid, colourless, polari-bilocular, ·0003″ long, ·0002″ broad. Thecæ 8-spored, ·0018″ long, ·00045″ broad. Hymenium deep blue with iodine; constituents comparatively distinct.

Sp. 6. L. UMBRINA, Ehrh. (Fig. 23.)

On stockyard palings of "Goai," Martin's bush, Chain-hills, Otago: W. L. L.: in fruit. Has a general resemblance to *L. erysibe*, Ach.

Spores (*a*, *b*) very variable in form and size, colourless, ·00025″ to ·0003″ long, ·00010″ to ·00015″ broad, generally simple, sometimes with one or two nuclei or loculi, which in the former case are generally central, in the latter, equally occupy the spore, divided by a septum as in ordinary 1-septate spores; sometimes margined in maturity, occasionally granular (young state), generally ellipsoid, sometimes oblong or pyriform or oval; occasionally even slightly constricted centrally, giving somewhat of a figure-8 character to their outline. Thecæ ·0009″ to ·0012″ long, ·0003″ broad. Paraphyses indistinct, closely aggregated at their tips. Hymenium deep blue with iodine.

On the same specimen, but quite apart from the apothecia, occur what, by the older lichenologists, would have been described as a *Pyrenothea*, and which may be the pycnides of the *Lecanora*. They are minute, black, verrucæform papillæ, somewhat conspicuous on a thin whitish thallus. The envelope or wall of the conceptacle consists of dark-brown, small, closely aggregated cells, from which project, internally, a series of simple short basidia (*c*), under ·0003″ long, springing from a brownish cellular hypothecium. These bear on their apices stylospores (*d*), curved, ·0003″ long, ·00015″ broad, oblong-linear, with rounded obtuse ends, simple or obscurely 1-septate, or containing one or two nuclei, generally central: coloured yellow by iodine.

Sp. 7. L. SUBFUSCA, Ach., var. *epibrya*, Ach. (Fig. 24.)

On weathered, decayed, tufted roots of grasses, Chain-hills, Otago: W. L. L.: associated with muscicolous forms of *Lecidea grossa*. Spores narrowly oblong-ellipsoid, simple, colourless, ·0003″ long, ·00012″ broad. Thecæ short; paraphyses-tips obscured by brownish granular colouring-matter. Hymenium blue with iodine; constituents indistinct.

Sp. 8. L. ATRA, Ach. (Fig. 25.) [*Parmelia*, Bab. L. N. Z.]

Corticolous: on trees, East Taeri bush.

Saxicolous: on basaltic boulders, top of Kaikorai Hill; on basalt (boulders, and *in situ*), Saddle-hill; on slaty trap and trap-conglomerate, Ferry Bluff, Clutha ferry, Otago: W. L. L. More or less common, apparently, on trap-rocks in the eastern districts of Otago. For the most part, Otago specimens, whether corticolous or saxicolous, are indistinguishable from the common British plant. The apothecia are sometimes large and handsome, irregular in surface or outline, the latter occasionally crenulate or wavy. Spores oblong-ellipsoid, simple, colourless, ·00045″ long, ·00028″ broad. Hymenium very deep blue with iodine. Thallus sometimes very white, thick, crustaceous, rimose or areolate, occasionally the site of a parasitic fungus, probably *Gassicurtia silacea*, Fée (Nyl. Prodrom. 91; Exs. 150), which affects the thallus or displaces the apothecia in the European plant. The parasitic *Microthelia gemmifera*, Tayl., may be looked for on the thallus of *L. atra* in New Zealand. The only New-Zealand specimen of *L. atra* I found in the herbarium Kew, is a North-Island one from Colenso.

Sp. 9. L. CINEREA, L. (Figs. 26, 27.)

On basaltic boulders, Kaikorai Hill; on trachytic rocks, Anderson's Bay; on slaty trap, Shaw's Bay, the Nuggets, and Kapuwaka Creek, Finegand, Lower Clutha, Otago: W. L. L. One of the common saxicolous *Lecanoræ* of Otago; associated with *Parmelia conspersa*, *Lecidea parasema*, and other lichens which are partial to basaltic or trappean rocks; as variable, apparently, in New Zealand as in Britain.

Spores (fig. 26) broadly ellipsoid, with a broad, distinct margin in maturity, simple, colourless, ·0009″ long, ·00045″ to ·0006″ broad, somewhat variable both as to size and form. The thecæ have the characters of those of *Pertusaria*, very large, ribbon-shaped, and distinct, 8-spored. The spores arranged in one or two rows, variable as to size and form, ·0045″ to ·0075″ long, ·0009″ to ·0015″ broad. No distinct paraphyses.

In herbarium Kew: Sweden (Acharius, 1809). Spores (fig. 27) oval, but variable in form, sometimes subpyriform; contained nuclei resemble vacuoles scooped out of solid spores; ·0005″ long, ·0003″ broad; thecæ ·0035″ long, ·001″ broad. On rocks at Lyn Bodlyn, near Barmouth, Salwey; spores ·0006″ long, ·0003″ broad.

Sp. 10. L. PARELLA, Ach.

On columnar basalt, Greenisland Bluff; on porphyritic basalt, the Forbury Head; on basaltic blocks, Signal-hill, North-east Valley, Dunedin; on slaty traps and trap-conglomerates, Ferry Bluff, Clutha ferry; on trappean cliffs, the Nuggets and Shaw's Bay, Otago: W. L. L. As variable as the British plant, from which it does not apparently differ, and as frequently sterile, and isidioid or sorediiferous. The latter forms are sometimes as abundant as in Britain, coating (especially basaltic or trappean) rocks to such an extent as materially to soften by their whiteness the blackness and bleakness of the stone, and so to become an important feature of the landscape. So frequently do crustaceous *Lecanoræ*, especially *L. parella* and *L. glaucoma*, whiten basaltic rocks, both at home and abroad, that they may to a great extent be regarded as diagnostic thereof.

Corticolous forms of *L. parella* I found in abundance on the palings of the Zoological Garden at Botany Bay, New South Wales (fig. 28), having the ordinary characters, viz., spores (*b*, *c*) oblong-ellipsoid, simple, colourless, ·0021″ to ·0024″ long, ·0009″ broad; thecæ (*a*) 8-spored, ·0075″ to ·0090″ long, ·0024″ broad; paraphyses indistinct, very delicate, and filiform, without coloured or clavate heads; hymenium very pale blue or colourless under iodine. By ammoniacal maceration, on the small scale, it yielded when fresh, a port-wine or brownish-red colouring-matter, which gradually assumed a rich crimson or purple hue on full aëration or oxygenation.

Foreign corticolous forms are apt to be confounded with *Dirina repanda*, Fr., which, however, is easily distinguished on microscopical examination by its fusiform, crescent-shaped (curved), 3-septate, colourless *spores*.

L. glaucoma, Ach., occasionally accompanies *L. parella*; it occurs on basalt on Saddle-hill. When looked for, it will probably be found to be a more frequent companion (also on trappean rocks) of *L. parella* throughout New Zealand than is at present known.

Sp. 11. L. SIMPLEX, Dav. (Fig. 29.)

On trachytic rocks, coast-cliffs, Anderson's Bay, Dunedin, Otago: W. L. L. Somewhat resembles *Lecidea coarctata*, Ach.; apothecia minute, difform; disk dark chestnut-brown; margin subinvolute on the disk, and irregular in outline.

In herbarium Kew there are specimens from Rev. H. Davies himself: on slate, Anglesea. Apothecia (fig. 29) variable as to form, spherical to lirellæform or angulous frequently difform, sometimes confluent; colour wholly black, or disk sometimes of a deep red, and generally flat; margin always black, raised, deeply and irregularly notched or crenulate, sometimes subinvolute on and obscuring the disk. Thecæ polysporous. The plant appears referable to *Lecanora pruinosa*, Sm. E. Bot. 2244; which, again, may be referred to *L. cervina*, Pers.

Genus XXIV. Urceolaria. (Plate LXII.)

Sp. 1. U. scruposa, Ach. (Fig. 30.)

On the ground in a steep gully descending to the sea, Green-island Bluff, Otago: W. L. L. Thallus more verrucose, and apothecia more urceolate and hidden than is usual in British specimens, which, however, are otherwise the same; margin thick and involute on the disk. Spores oval, irregular in outline from bulging of the envelope or epispore opposite the muriform loculi; dark brown or olive, according to age, ·0009″ long, ·00045″ broad. Thecæ and paraphyses indistinct. Hymenium not blue with iodine. The thallus contains abundant crystals of oxalate of lime, amorphous or in octahedra about ·0006″ to ·0009″ across.

Sp. 2. U. stictica, Krb. (Fig. 31.) [Nyl. L. N. Z. 252.]

On tertiary grits and conglomerates, base of Saddle-hill, Otago: W. L. L.: associated with *Parmelia Mougeottii*. Resembles in colour of thallus and the appearance of the suburceolate apothecia, some forms of *Lecanora cinerea*. Spores broadly oval, regular in outline, brown or olive and muriform as in *U. scruposa*, ·0009″ long, ·0006″ broad. Thecæ 8-spored, long, ribbon-shaped, not affected by iodine. Spores arranged in a single series.

Genus XXV. Pertusaria. (Plate LXIII.)

Sp. 1. P. communis, DC. (Fig. 1.)

On living trees, East Taeri bush; on bark of dead trees, Saddle-hill bush; on stock-yard palings of "Goai," Martin's bush, Chain-hills, Otago: W. L. L.: partly in fruit, partly variolarioid and sterile. Thallus smoother and more of a pale yellow colour than in British specimens, which otherwise the Otago plant resembles. Apothecial verrucæ large, and subdiscrete or solitary.

Spores oblong-ellipsoid, simple; endospore colourless or pale yellow; broadly margined, ·0060″ to ·0090″ long, ·0024″ to 0030″ broad. Endospore transversely and much plicate, the wavy plications forming a serrate outline, and so close and fine that, viewed in certain lights, they appear like a series of minute reticulations entirely covering the endospore, and in some cases also the epispore; the outline of the epispore is always regular and entire, however, while that of the endospore is serrate or finely frilled. Nylander apparently regards the "endosporio plicatulo" as a basis for a specific form or variety; but, though far from common, I have met with transverse plication also in the common British plant. Longitudinal plications are not uncommon in all the *Pertusariæ*, British and foreign, both, apparently, of epi- and endospore, though they are generally confined to the latter; but usually there are few (two or three only). Longitudinal plications of both epi- and endospore are also visible frequently in old spores, prior to the elongation of the endospore and germination.

Thecæ 1-spored, in tufts, very large, broadly ribbon-shaped, and beautiful (especially when blue under iodine), ·012″ long, ·003″ broad. Paraphyses indistinct, very delicate, filiform, without thickened or coloured heads. There are in lichens few hymenia more beautiful (especially under iodine), or more instructive for examination by the student, than that of the ubiquitous British *P. communis*.

Sp. 2. P. VELATA, Turn. (Fig. 2.) [Nyl. L. N. Z. 253.]

On columnar basalt, Greenisland Bluff; on basaltic boulders, beach south of the same, Otago: W. L. L.: in fruit. The plant has a close general resemblance to *Lecanora glaucoma*, with which it may readily be confounded. Thallus very white, thick, and tessellated, made up apparently of a series of subangular isidiiform areolæ, which, in the old state, frequently fall away from their base of adhesion or support, producing ragged or irregular excavations of the thallus. The apothecia are perched each on the apex of one of these cushion-like areolæ, and are, with the thallus, white-pruinose, frequently copiously so, by which the waxy flesh-coloured disk of the lecanorine apothecium is obscured and altered in appearance, as occurs in *L. glaucoma*, *L. parella*, and *L. tartarea*. The plant is frequently sterile, and isidioid or sorediiferous like the *Lecanoræ* just mentioned; and this sterile form is likely to be found abundant in Otago, and one source at least of that white coating of the coast-cliffs (of trappean rocks) as common there as in Britain. Probably it will prove, in this respect, to occupy the place in New Zealand of the white crustaceous *Lecanoræ* of Britain, compared with which it is, especially in fruit, quite as handsome a plant. Spores ellipsoid or oblong-ellipsoid, broadly margined, endospore pale yellow, ·0075″ to ·0090″ long, ·0030″ to ·0045″ broad, frequently with one or more longitudinal plications, and occasionally with a few transverse terminal ones, apparently of the epispore. Thecæ large, 1-spored, very pale blue with iodine, as is also the hymenial lichenine. Save the general transverse plications of the endospore in Otago forms of *P. communis*, the characters of spores and thecæ are identical with those in *P. velata*. As in British forms, the plications and relations of epi- and endospore are best examined under a low power (half-inch object-glass, 100 to 150 diameters linear).

Genus XXVI. THELOTREMA. (Plate LXIII.)

Sp. 1. T. LEPADINUM, Ach. (Fig. 3.)

On the bark of living trees, especially Coniferæ, East Taeri bush; on the trunks of trees, living and dead, Greenisland bush; on stock-yard palings of "Goai," Martin's bush, Chain-hills, Otago: W. L. L.: all in fruit; one of the most plentiful corticolous crustaceous lichens of the Greenisland district of Otago. The Otago plant resembles in its buff colour and mealy thallus, specimens from warm countries rather than its British representatives. The sterile form of the thallus probably includes much of what would be called cortical *Variolariæ* by the older lichenologists, being, apparently, more common on the forest-trees of Otago than *Pertusaria communis* or the white, crustaceous, corticolous *Lecanoræ*.

Spores variable in form and size, fusiform, rounded at ends, sometimes subangulous or broader at one end, colourless, muriform, ·0024″ to ·0036″ long, ·0006″ broad. Thecæ 8-spored, not affected by iodine, very large, ·0060″ long, ·0012″ broad. Paraphyses discrete, filiform, colourless, considerably exceeding thecæ in length, without clavate heads; tips obscured by a slight amount of granular greenish-yellow colouring-matter. Hymenium unaffected by iodine, in section one of the most beautiful and instructive among lichens. Hypothecial cellular tissue granular, pale green yellow.

Specimens resembling the Otago plant occur in herbarium Kew, from the North Island (Colenso), in fruit.

Sp. 2. T. MONOSPORUM, Nyl. [L. N. Z., 254.] (Fig. 4.)

On the branches of trees, East Taeri bush, Otago: W. L. L: associated with *Parmelia pertusa* and other common corticolous lichens. Spores fusiform, subangulous, with obtuse rounded ends, muriform, yellowish in the young state and while in the thecæ, gradually assuming an olive or brown tint, more or less dark, according to age, ·0036″ to ·0045″ long, ·0009″ broad. Thecæ 1-spored, resembling, with their spores, those of *Lecanora chrysosticta*. Paraphyses discrete, filiform, colourless, without clavate heads, considerably exceeding thecæ in length. Hymenium unaffected by iodine; beautiful in section under the microscope. Hypothecium scarcely coloured.

The 1-spored thecæ and the brown or olive spores render it impossible to confound this with the preceding much commoner species.

Genus XXVII. CŒNOGONIUM. (Plate LXIII.)

Sp. 1. C. IMPLEXUM, Nyl. (Fig. 5.)

On trunks of trees, living and dead, Saddle-hill bush, Otago: W. L. L.: partly in fruit, partly sterile. The apothecia have much the aspect of those of *Gyalecta*, both as to colour and form; they vary from urceolate in the young, to convex in the old state. The disk sometimes becomes pale, or, in the old state, it falls away, leaving the pale cup of the hypothecium. The flesh-coloured apothecia contrast beautifully with the green of the fur-like thallus, which consists entirely of a filamentous confervoid tissue, giving it the character of an Alga on one hand, and of a Fungus (*Dictyonema*, Hymenomycetes, sect. *Auricularini*) on the other. The thalline filaments consist of tubules resembling those of Confervæ, about ·00045″ to ·0006″ broad, long, irregularly branching, divided into loculi or elongated cellules of unequal size and full of green granular colouring-matter (chlorophyll). The apothecia and their contents have much of the characters of those of *Lecidea pineti*. Hymenium colourless or very pale blue under iodine. Paraphyses discrete, with slightly thickened heads, which are of a pale yellowish-brown tint. Thecæ 8-spored, ribbon-shaped, ·0024″ long, ·00025″ broad. Spores (*e*) ellipsoid, colourless, 1-septate, ·0003″ long, ·0002″ broad. Hypothecium pale brownish yellow.

Genus XXVIII. Lecidea. (Plate LXIII.)

Sp. 1. L. pineti, Ach. (Fig. 6.)

On trunks of trees, living and dead, Saddle-hill bush, Otago: W. L. L.: associated with sterile forms of *Cœnogonium implexum.* There is no visible thallus, the apothecia (which are mostly young) being seated directly on the bark. There is a general resemblance to the apothecia of the *Cœnogonium*; so that they might be regarded as referable to an *a*thalline condition of the latter. But there are certain differences in the spores and paraphyses, which, along with the absence of a thallus, and the correspondence in essential characters with the British *L. pineti*, lead me to refer the apothecia in question thereto. Under moisture they lose their beautiful pale peach-colour, and become corneous or semitranslucent. The hymenium sometimes exhibits a very faint shade of blue or violet under iodine; more generally it is unaffected. Paraphyses discrete, filiform, distinct, with tuberculated heads, full of granular very pale greenish-yellow colouring-matter. Spores variable as to size and form, broadly or narrowly ellipsoid, oval, or fusiform, normally 1-septate (septum not always median), sometimes simple or obscurely septate, colourless, ·00045″ long, ·0008″ broad. Here the spores are longer generally, more slender, and more variable than in *Cœnogonium implexum.*

Sp. 2. L. cinnabarina, Fr. (Fig. 31.) [*Biatora*, Bab. L. N. Z. plate cxxix. *c*.]

In herbarium Kew: North Island, New Zealand, associated with forms of *Usnea barbata* (Colenso, No. 5291); Tasmania, on twigs of bushes. One of the most beautiful corticolous *Lecideæ* of any country. Apothecia of a bright vermilion-red; they resemble those of some forms of *Lecanora ferruginea.* The latter, however, has polari-bilocular spores; while in *L. cinnabarina* they are fusiform or ellipsoid, simple, colourless, ·00033″ long, ·00012″ broad.

Sp. 3. L. pyrophthalma, Mont. (Fig. 32.)

In herbarium Kew: North Island, New Zealand (Colenso, No. 1216). Another beautiful corticolous species, with very handsome, large, convex, irregular, deep saffron-yellow apothecia. The plant has considerable resemblance to *L. lutea*, Sch., as it occurs, for instance, in Ireland (Carroll): the apothecia are similar; but the spores in *L. pyrophthalma* are somewhat larger, they are fusiform, 1-septate, colourless, ·0005″ long, ·00011″ broad. The plant has been variously referred to forms of *Lecanora aurantiaca* (var. *lætissima*, Bab.), and *L. calva*, Dicks. but the spores are quite different from those of either, those of *L. aurantiaca* being, as in *L. ferruginea*, polari-bilocular or physcioid, those of *L. calva* simple.

Sp. 4. L. arceutina, Ach. (Fig. 7.) [Nyl. L. N. Z. 256.]

On trees, Stoney-hill bush; East Taeri bush; Greenisland bush, Otago: W. L. L.: associated with *Thelotrema lepadinum*, *Verrucaria nitida*, Schrad., and its var. *nitidella*, Flk., and with other corticolous species. Apothecia resembling externally those of L.

grossa; colour always black; they often become convex, immarginate, and difform. The hymenium (*a*, *d*) gives a beautiful blue with iodine, the coloration extending from the tips of the paraphyses to their base, and including the hymenial lichenine, and all the constituents of the hymenium. Occasionally, however, the coloration in question is very slight, and is much less extensive or general. Sometimes the hymenium contains immense quantities of oil-globules of all sizes. Paraphyses (*a*) discrete, filiform, with large tuberculated heads, consisting of one or more subspherical or irregular superimposed cellules, full of granular blackish-brown colouring-matter; tips loosely aggregated; shape (but not colour) resembles that in some forms of *Physcia parietina*. The paraphyses are here unusually (for the genus *Lecidea*) distinct and easily studied. Thecæ (*b*) 8-spored, ·0024″ to ·0030″ long, ·0006″ broad. Spores (*e*, *f*) linear or acicular, delicate, and frequently indistinct, apt, when their septa are not distinct, to be confounded with the bodies or filaments of the paraphyses; colourless, polyseptate (frequently 8–10 septa), ·0015″ to ·0021″ long, ·00008″ to ·00010″ broad.

On one specimen, associated with *Thelotrema lepadinum*, spermogones occur as minute, black, punctiform conceptacles, seated on white thalline wartlets, external to the region occupied by the apothecia, which are degenerate (exhibiting no spores). Spermatia linear, straight, ·00015″ long, ·00006″ broad, seated on short simple sterigmata (*g*) about ·00015″ long.

Sp. 5. L. PULVEREA, Borr., var. *Laurocerasi*, Dél. (Figs. 8, 9.) [Nyl. L. N. Z. 255.]

On trees, Stoney-hill bush; Martin's bush, Chain-hills, Otago: W. L. L.: associated with *Verrucaria nitida* and other corticolous lichens. The apothecia are extremely variable, especially as to colour and form; they bear a general resemblance to those of the New Zealand *L. melanotropa*, Nyl. (L. N. Z. 255; Linds. Obs. Otago Lich. and Fungi, p. 412, plate xxix. fig. 10), and of the British *L. carneola*, Ach. (*Lichen corneus*, Sm. E. Bot. t. 965). In *L. pulverea*, var. *Laurocerasi*, the apothecia generally remain marginate in their normal though old condition; the disk is always darker than the margin, which is generally somewhat rugulose or crenulate, and subinvolute on the disk; sometimes the disk becomes turgid. Both disk and exciple have generally a waxy aspect; under moisture this appearance is rendered more distinct, and a semitranslucent or horn-like condition is frequently produced. Even in the same apothecium or specimen, and still more in different specimens, the apothecia present different shades and combinations of brown and black, the former predominating, the disk and its margins possessing generally different tints. These tints, especially the browner ones, are rendered more distinct by moisture, which causes the apothecia frequently to swell into brownish-yellow, subspherical, semitranslucent masses resembling dried beads of gelatine.

Even without moisture the apothecia occasionally assume such an appearance, when they become difform and degenerate; in these cases the hymenium gives a beautiful blue reaction with iodine, but shows no distinction of thecæ, spores, or paraphyses. In normal apothecia the hymenium also gives a fine blue colour with iodine. Paraphyses subdiscrete, filiform, with dark-brown, granular, thickened but not tuberculiform tips. Thecæ 8-spored, ·0030″ long, ·0006″ broad. Spores linear or acicular, with the characters of those of *L. arceutina*, as delicate and nearly as long as the bodies (filaments) of the paraphyses, with which they are apt to be confounded when their septa are indistinct (as they generally are) or invisible; colourless, polyseptate, ·0015″ to ·0224″ long, ·00008″ to ·00010″ broad.

Sp. 6. L. SABULETORUM, Flk. (Fig. 10.)

On mica-slate, Otokia Bluff; on the face of the limestone cliffs near Greenisland church, Otago: W. L. L.: in fruit, but apothecia seen with difficulty, unless moistened. Hymenium beautiful blue with iodine; constituents indistinct. Hypothecium granular, dark brown. Paraphyses-tips closely aggregated, and covered by a brownish-yellow membrane. Thecæ ·0024″ to ·0030″ long, ·0006″ broad. Spores fusiform, colourless, polyseptate, ·00075″ to ·0009″ long, ·0002″ broad.

Sp. 7. L. FURFURACEA, Pers. (Fig. 11.)

On trunks of dead trees, Saddle-hill bush, Otago: W. L. L. Spores ellipsoid or sub-oblong, colourless, simple, ·00025″ to ·00030″ long, ·0001″ to ·0002″ broad. Thecæ short, 8-spored, ·0012″ long, ·00045″ broad; blue with iodine, as is also generally the hymenium. Paraphyses-tips brown, closely united; paraphyses, spores, and thecæ all more or less indistinct.

Sp. 8. L. MARGINIFLEXA, Tayl. (Fig. 12.)

On the trunks of dead trees, Greenisland bush, Saddle-hill bush, and East Taeri bush, Otago: W. L. L.: in fruit; one of the commonest and most prominent corticolous *Lecideæ* of the Greenisland district of Otago. Its apothecia have externally the characters of those of *L. grossa*; but the 1-spored thecæ and large spores at once distinguish it.

Spores in maturity (*b*) oblong, 1-septate, generally a constriction at or opposite the septum, giving them a figure-8 outline; colourless, ·0045″ to ·0060″ long, ·0015″ broad, easily divided into two halves (*d*) at the septum by friction of the microscope-slides; in the young state simple, with a protoplasm largely oily (in globules of all sizes). Thecæ 1-spored; blue with iodine. Paraphyses subdiscrete, delicate, filiform, with brown tuberculated tips. Apothecia large, prominent, black; scattered sparingly over the conspicuous, white, crustaceous thallus; variable as to colour. Disk sometimes glaucous, white-pruinose, or citrine yellow, resembling in its hues *L. leucothalamia*, Nyl. (L. N. Z. 255): it occasionally becomes eroded or falls away, leaving the pale flesh-coloured hypothecium. Exciple also sometimes eroded; old apothecia sometimes become degenerate and difform, pale-coloured, convex, and biatorine. Spermogones abundant and distinct as subperipheral black conceptacles crowning minute thalline tubercles.

In herbarium Kew there is considerable confusion with *L. grossa*. A Tasmanian specimen is referred by Nylander, and rightly, I think, to *L. grossa*. In a North-Island New-Zealand form (from Colenso, No. 5317, woods, Kawakawa, on bark, 1843), the apothecia are white-pruinose, the margin distinct and thick, the thallus creamcoloured, the thecæ 1-spored, the spores figure-8-shaped, 1-septate, colourless, broadly oblong-oval, ·0040″ to ·0050″ long, 0016″ broad.

Sp. 9. L. GROSSA, Pers. (Figs. 13–15.)

On trunks of living trees, Greenisland bush, Stoney-hill bush, and East Taeri bush; *a*thalline, on dry, weathered, dead stems and roots of grasses and carices, matted in tufts, Forbury cliffs, Otago: W. L. L. Next to *L. marginiflexa*, one of the commonest and most prominent corticolous *Lecideæ* of the Greenisland district of Otago.

Spores (fig. 13 *d*, *e*) somewhat variable in form and size, generally broadly ellipsoid or subspherical, sometimes oval or pyriform; colourless, 1-septate, septum not always median; ·0009″ to ·0012″ long, ·00045″ to ·0005″ broad. Thecæ (*b*) 8-spored, ·0045″ long, ·0012″ to ·0015″ broad, beautiful blue with iodine. Paraphyses (*a*) subdiscrete, delicate, filiform; tips tuberculiform, obscured by much dark, brownish-black, granular colouring-matter. Hymenium (*b*, *c*) beautiful blue with iodine; the coloration extending from, and deepest at, the tips of the paraphyses; in section very distinct and instructive, one of the best in which to study the anatomy of the apothecium of the genus *Lecidea*. Both hypothecium and epithecium dark brown. Apothecia sometimes white-pruinose. Thallus sometimes thick and coralloid or isidiiform, resembling certain forms (muscicolous and corticolous) of *Lecanora parella* and *L. tartarea*, or, it may be, thin, or altogether (apparently) absent. In general external characters the plant has a resemblance to various other *Lecideæ*, equally or more common at home and abroad, including especially *L. disciformis*, *L. parasema*, *L. marginiflexa*, and *L. premnea*—so much so that, in the Hookerian and other herbaria, there is great confusion between these species, which in all cases require microscopical examination for their discrimination. Fortunately their spores at once distinguish them.

A specimen in herbarium Kew (fig. 15) [sub nom. *L. premnea*, Ach., on bark, Forfar (Drummond)] has colourless, oval-oblong, 1-septate spores, ·00083″ to ·0010″ long, ·0005″ broad, and thecæ ·005″ long, ·0013″ broad. Few British species have handsomer spores or thecæ. A specimen from the United States of America (Green, No. 71) is labelled *L. parasema*, while others are erroneously labelled *L. disciformis*, and *vice versâ*. In a specimen in my herbarium from Rio Janeiro (fig. 14) [Henry Paul, 1846], the thecæ (*a*) are subsaccate, blue with iodine, developing only two spores—a condition approaching the 1-spored *L. marginiflexa*. The loculi of the spores (*b*, *c*) are sometimes pale brownish yellow; under iodine, as is generally the case with the colourless spores of lichens, they acquire a deep yellow tint, while their protoplasm or contents assume a subgranular appearance (*d*).

Sp. 10. L. DISCIFORMIS, Fr., var. *albula*, Nyl.

North Island, on limestone (Colenso): in herbarium Kew. Apothecia scattered on a mealy white thallus,—the whole plant resembling certain forms of *L. albo-atra*, Hffm.

On columnar basalt, Greenisland bluff, Otago, associated with *L. lenticularis*, Ach. (Nyl. L. N. Z. 257), is a difform condition, which I refer to this species, or to some of the allied species, such as *L. myriocarpa* and *L. stellulata* (which, I think, should be considered mere forms or varieties of *L. disciformis*). The spores (fig. 16) have all the characters of those of *L. disciformis*:—In old and subdegenerate apothecia, broadly ellipsoid, 1-septate or bilocular, the loculi in the young state being nucleiform and subspherical; constricted (or not) opposite the septum (where it exists); frequently, especially in the old state, figure-8-shaped; various shades of olive when young, dark brown with age, ·0006″ to ·00075″ long, ·00045″ broad. Hymenium very dark blue; apothecia subangulous, somewhat resembling those of the genus *Melanospora*, with an irregular margin and outline. Thallus white.

Corticolous forms of *L. disciformis* do not yet appear to have been found in New Zealand; the saxicolous forms are not only rare, but by systematists would probably be referred to some of the allied species, particularly *L. myriocarpa*. In New South Wales, on the other hand, I found corticolous forms abundant, *e. g.* on the old palings of the Zoological Gardens, Botany Bay, near Sydney. It does not, however, appear to me distinguishable properly from *L. myriocarpa*. Spores (fig. 17) oblong or oblong-ellipsoid, 1-septate, constricted or not; septum sometimes not median, and upper division of spore broader and shorter than lower (soleæform, as in *Abrothallus Smithii*, *L. myriocarpa*, and the saxicolous Otago form of *L. disciformis*), brown, ·00045″ long, ·00025″ broad. Thecæ 8-spored, ·0015″ long, ·0006″ broad. Paraphyses indistinct, tips obscured by blackish-brown granular colouring-matter. Hymenium beautiful blue.

Sp. 11. L. MYRIOCARPA, DC. (Figs. 18, 19.) [Nyl. L. N. Z. 257.]

a. Corticolous. On twigs of shrubs, East Taeri bush.

b. Saxicolous. On porphyritic basalt, Forbury Head; on basaltic boulders, top of Kaikorai Hill (associated with *Parmelia conspersa*, &c.); on mica-slate, Glen Martin, Chain-hills, Otago: W. L. L. The plant has a general resemblance to many associated saxicolous *Lecideæ*, such as *L. parasema* and *L. contigua*, but its spores at once separate it from the simple and colourless-spored group of the *Lecideæ*.

Spores oblong-ellipsoid, 1-septate, constricted or not, sometimes figure-8-shaped, sometimes soleæform, brown, ·0003″ to ·00045″ long, ·00015″ to ·0003″ broad; variable in size and form; in young state even simple and subspherical, with one central nucleus, or two nuclei, instead of distinct loculi. Thecæ 8-spored, narrow or broad, according as the spores are arranged in one or two rows, ·0012″ long, ·00045″ broad. Paraphyses subdiscrete, tips granular, brown. Hypothecium brown. Hymenium beautiful blue with iodine, sometimes obscured by dark brown granular colouring-matter.

In specimens in herbarium Kew ("on oaks near Yarmouth, 1805; and on gate-posts at Halewith, 1805" [Borrer, apparently]), the spores (fig. 19) are brown, 1-septate, ·0005″ long, ·0002″ broad.

Sp. 12. L. STELLULATA, Tayl. (Fig. 20.)

On basalt, south peak of Saddle-hill, Otago: W. L. L. Thecæ and spores essentially those of *L. myriocarpa*, from which I fail to distinguish this species by any good characters. Spores oblong-ellipsoid, 1-septate, brown, ·0003″ long, ·0002″ broad. Thecæ 8-spored, ·0012″ long, ·0006″ broad.

Sp. 13. L. PETRÆA, Flot. (Fig. 21.)

On mica-slate, Glen Martin, Chain-hills, Otago: W. L. L. Has somewhat the facies of *L. fusco-atra*. Under moisture, many of the thalline scales or areolæ assume a green or yellow tint—the character of the thallus of *L. geographica*. Spores variable in size and form, generally oblong-ellipsoid, muriform, dark brown, ·0012″ long, ·00045″ broad; in the young state the colour is usually olive, and the spore-outline regular, with a symmetrical form; in the old state there are generally bulgings of the epispore opposite the muriform or divided loculi or nuclei, and the form becomes frequently irregular, sometimes elongated and pyriform. Thecæ and paraphyses very indistinct.

L. geographica occurs on basaltic blocks, Signal-hill, North-east Valley, Dunedin; on slaty trap and trap conglomerate, Ferry Bluff, Clutha ferry; and it is abundant on gneiss and mica-slate on the Tuapeka ranges.

Sp. 14. L. PARASEMA, Ach. (Fig. 22.)

a. Corticolous. On trunks of living trees, Greenisland bush. Indistinguishable in external characters from *L. grossa*, *L. marginiflexa*, and other corticolous *Lecideæ* more or less common in Otago; but at once separated by its *spores*, which are simple, oblong-ellipsoid, colourless, margined in maturity, ·00045″ to ·0006″ long, ·00025″ broad. Thecæ 8-spored, ·0036″ long, 00045″ broad. Paraphyses indistinct, tips dark brown, granular. Hymenium blue with iodine.

b. Saxicolous. On mica-slate, Glen Martin, Chain-hills; on tertiary grits and conglomerates, base of Saddle-hill. Passes gradually into var. *latypea*, Ach. Thallus granulous. Apothecia frequently turgid and subspherical, or lobulate, or tuberculated; when old and subspherical they sometimes fall away, leaving a whitish saucer-like scar or hollow of the thallus; frequently crowded, sometimes confluent, marginate in the flat normal condition of the disk, immarginate in the subspherical and difform conditions; marginate forms often subangulous from mutual pressure; sometimes white-pruinose; margin usually very thin and evanescent, sometimes crenulate or irregular.

Var. *latypea*, Ach. (Fig. 23.)

Saxicolous: on mica-slate, Glen Martin; on tertiary grits and conglomerates, base of Saddle-hill; on basaltic boulders, top of Kaikorai Hill (associated with *Parmelia conspersa* &c.); on basaltic porphyry, Forbury cliffs (associated with *Lecanora thiomela*, Nyl. L. N. Z. 252; Linds. Obs. Otago Lich. and Fungi, p. 414, plate xxix. fig. 16), Otago: W. L. L. Not unfrequently associated with, and passing into, the type or other forms of *L. parasema*.

Spores oblong-ellipsoid, sometimes exhibiting variations in form (subpyriform, plano-convex, slightly curved as in *Ramalina*), simple, colourless, margined in maturity; ·00045″ to ·0006″ long, ·00025″ to ·00045″ broad. Thecæ 8-spored, ·0018″ to ·0030″ long, ·0006″ to ·00075″ broad. Paraphyses subdiscrete, filiform; tips loosely united, blackish-brown, granular. Hymenium, including the thecæ, deep blue with iodine. Spermogones occur on one specimen—mostly, however, old and degenerate, as minute black tubercles, resembling some of the smallest species of *Verrucaria* or *Microthelia*, seated on white thalline warts outside the region occupied by the apothecia. In var. *latypea* the spores are larger than in the following variety, and the constituents of the hymenium generally more distinct.

The apothecia, as in all the forms of *parasema* in New Zealand, are extremely variable. In some specimens they maintain their normal flat disk, thin but distinct margin, and black colour, while they are discrete or solitary. In other cases, they become crowded or confluent, subangulous from pressure, pruinose, turgid, convex, or subspherical, or difform, with irregular sinuate or crenulate margin. The thallus also varies somewhat in character; it is tartareous, thick or thin, white or greenish, granular or farinose.

Var. *enteroleuca*, Ach. (Fig. 24.)

Saxicolous: on mica-slate, Glen Martin; on gneiss boulders, coast ranges, Anderson's Bay, Dunedin, Otago: W. L. L. Apparently less common than var. *latypea* in the Greenisland district of Otago.

Spores smaller than in *latypea*, but equally variable, in form especially; normally ellipsoid or oblong-ellipsoid, but occasionally subpyriform or even subspherical: straight or slightly curved, simple, colourless, ·0003″ long, ·00025″ broad. Thecæ 8-spored, ·0012″ to ·0015″ long, ·0045″ to ·006″ broad. Hymenium beautiful blue with iodine; constituents frequently very indistinct, sometimes as much so as in *L. fusco-atra*. Apothecia much smaller than in *latypea*, but frequently, as in that variety, subglobose or difform; sometimes coarctate, resembling *L. coarctata*. Thallus generally very thin and whitish, frequently apparently absent. Throughout the forms of *parasema* there is considerable variability as regards the form and size of the spores, the size of the thecæ, the distinctness of the constituents of the hymenium, and the external characters of the apothecia and thallus.

Sp. 15. L. CONTIGUA, Fr.

On basaltic blocks, Signal-hill, North-east Valley, Dunedin; on slaty traps and trap conglomerates, Ferry Bluff, Clutha ferry, and Shaw's Bay, the Nuggets, Otago: W. L. L. Occasionally with a rust-coloured (ferruginous) thallus as at home. Apt to be confounded on the one hand with *L. parasema*, and on the other with *L. lapicida*. *Microthelia gemmifera*, Tayl., is as likely to occur parasitic on its thallus in New Zealand as in Britain.

Var. *crustulata*, Ach. (Fig. 25.)

On tertiary grits and conglomerates, base of Saddle-hill, Otago: W. L. L. Spores oblong-ellipsoid, simple, colourless, 0003″ long, ·0006″ broad; found only in the young, papillæform condition of the apothecia. Hymenium blue with iodine; constituents indistinct. Apothecia occasionally only exhibiting the fully expanded flat disk; more generally they are suburceolate, having a thick, corrugate, subinvolute margin: in the young condition they are papillæform, resembling some of the larger saxicolous *Verrucariæ*. The thallus covers the red or yellow grits with a more or less uniform or smooth though subareolate coat or crust, on which the black apothecia are conspicuous. The plant has a general resemblance to certain forms of *L. petræa,* on the one hand, and *L. lapicida* (var. *declinans*) on the other.

Var. *meiospora,* Nyl. (Fig. 26.)

On hardened mud or clays, Great North Road, about two miles from the town of Auckland: W. L. L. Abundant; *a*thalline, or nearly so. Spores oblong-ellipsoid, simple, colourless, ·0006″ long, ·0003″ broad; in the young state, and within the thecæ, subangulous from mutual pressure, as is general in lichen-spores. Thecæ 8-spored (spores arranged in one or two rows), ·0024″ long, ·0006″ broad. Paraphyses-tips indistinct, very dark brown. Hymenium beautiful deep blue with iodine.

Sp. 16. L. LAPICIDA, Fr., var. *declinans,* Nyl. (Fig. 27.)

On tertiary grits and conglomerates, base of Saddle-hill, Otago: W. L. L. Has a general resemblance to forms of *L. contigua* (var. *crustulata*), and *L. parasema.* Apothecia generally thin, flat, frequently crowded or confluent, and subangulous or difform, with a sinuate or crenulate border; conspicuous on the thin, white, smoothish areolate thallus. As compared with var. *crustulata* of *L. contigua,* the thalline areolæ are much smaller, while the apothecia are larger and more crowded, more than one being frequently seated on the same areola.

Spores oblong-ellipsoid, simple, colourless, ·00025″ long, ·00015″ broad. Hymenium blue with iodine, but constituents indistinct; hence one of the worst species in which to study the anatomy of the apothecium in the genus *Lecidea.*

In herbarium Kew is a specimen from the North Island (Colenso), which may be referable to the type rather than to var. *declinans.*

Sp. 17. L. FUSCO-ATRA, Ach.

On basalt, south peak of Saddle-hill; on rocks subjacent to the trap tuff, Government coal-pit, Scrogg's Hill; on basaltic boulders, top of Kaikorai Hill; on trappean rocks, Shaw's Bay, Otago: W. L. L. Quite the British plant. Hymenium deep blue with iodine, but constituents very indistinct, so that neither spores nor thecæ (both of which are small), nor paraphyses (which are closely aggregated) were satisfactorily seen. The spores, indeed, of this species, like those of several of the *Cladoniæ,* notwithstanding the abundance and prominence of the apothecia, are seldom distinctly seen in specimens from any part of the world. In herbarium Kew there are Scotch specimens from Don, 1805 (sub nom. *L. fumosa,* Ach.), with broadly ellipsoid, simple, colourless spores, ·0004″ long, and ·0002″ broad, and very delicate filiform paraphyses.

Sp. 18. L. COARCTATA, Ach.

On basaltic boulders, Stoney Hill, Otago: W. L. L. Contains no spores, but agrees in external characters with specimens in Schærer's Exs. 312, and in my herbarium (on trap rocks, Kinnoul Hill, Perth). In herbarium Kew there is also a specimen referred to the type, from the North Island (Colenso).

Var. *exposita,* Nyl. (L. N. Z. 254; Linds. Obs. Otago Lich. and Fungi, p. 413, plate xxix. fig. 12), occurs on tertiary grits and conglomerates, base of Saddle-hill, Otago.

Genus XXIX. ARTHONIA. (Plate LXIII.)

Sp. 1. A. EXCEDENS, Nyl. (Fig. 28.)

On stockyard palings of "Goai," Martin's bush, Chain-hills; on bark of trees, East Taeri bush, Otago: W. L. L.: associated with *Thelotrema lepadinum*, and various corticolous *Lecideæ*. Apothecia resembling the degenerate apothecia of various corticolous *Lecideæ*; they are raised, subdiscoid, and subspherical, seated on a white circumscribed thallus. Spores variable both in form and size; their size ranges from ·0009″ to ·0015″ long, ·0003″ to ·0006″ broad; most usually they are pyriform and straight; sometimes they are broadly ellipsoid, occasionally slightly curved; normally they are polyseptate, eight being the commonest, and six the next commonest number of septa; the upper loculi always the largest in the pyriform spore, the central one generally in the ellipsoid condition; with age the loculi become sometimes submuriform, while in the young state they are round, nucleiform, and moniliform; or, both in the old and young state, the protoplasm from which the loculi are formed consists of amorphous matter, granulous-oily; mostly colourless, but exceptionally becoming brown with age, a circumstance common to many typically colourless lichen-spores. Thecæ saccate or broadly obovate, 8-spored, spores irregularly arranged; not blue with iodine; ·0021″ to ·0045″ long, ·0012″ to ·0021″ broad. Paraphyses indistinct. Hymenium generally unaffected by iodine, but sometimes pale blue or violet. Both spores and thecæ are very distinct; and, from their size also, this is a good species in which to study the minute anatomy of the apothecia of *Arthonia*.

Sp. 2. A. CONSPICUA, Nyl. (Fig. 29.) [*Myriangium inconspicuum*, Bab. L. N. Z. plate cxxviii. B.]

On trees, East Taeri bush, Otago: W. L. L. In herbarium Kew there is a North-Island specimen from Colenso (on a dead leaf of *Phormium tenax* apparently), which Nylander there refers (and in Syn. Lich. 139) to the British *A. lurida*, Ach.; in Lich. Novo-Granat. (67), however, he corrects this reference, and separates it as a species. The apothecia are somewhat lecidioid, raised and convex, deep brown: only in the young flat condition do they resemble those of *A. lurida*, from which this plant is abundantly distinct. Spores oblong-ellipsoid, 1-septate, constricted centrally, and having thus a figure-8 outline; brown, ·001″ long, ·0005″ broad; they have a general resemblance to some forms of those of *Physcia pulverulenta*. Thecæ broadly obovate, as is the typical form in *Arthonia*; ·0028″ long, ·0013″ broad. Regarding the same specimen in herbarium Kew, Berkeley notes that it is a smaller species than, and quite distinct from, *Myriangium Duriæi*, Mont. and Berk., with which, indeed, it has no true affinity.

Genus XXX. VERRUCARIA. (Plate LXIII.)

Sp. 1. V. GLABRATA, Ach. (Fig. 30.) (*V. alba*, Schrad., Bab. L. N. Z.)

On the very rugose barks of old trees, Martin's bush, Chain-hills; Martin's Quarry, Greenisland bush; on branches of trees and shrubs, Stoney Hill bush, Otago: W. L. L.

In fruit, and spermogoniferous; apothecia mostly degenerate, exhibiting no spores. There appear to be two forms of the plant, varying in the size of the apothecia, corresponding to the *major* and *minor* forms (type and var. *nitidella*) of *V. nitida*, a plant to which the present, in Otago specimens, has a general resemblance. These *major* and *minor* forms are further distinguished by *spermogones*, which differ in the character of their spermatia—an instance of polymorphism or plurality in the fructification of the lower lichens which is far from uncommon.

1. *Minor* form (*b*). Spermogones abundant, especially about the periphery of the thallus (which follows all the rugosities and fissures of the bark, to which it is intimately adherent), and scattered among the apothecia as minute black papillæ, similar in external character, but inferior in size, to the apothecia themselves. Spermatia (*b*) in myriads, very delicate, linear, curved, ·00045″ long, ·00005″ broad, generally more or less straight while articulated to the sterigmata; sterigmata also linear, tapering superiorly, simple, ·0006″ to ·0009″ long, arising from a pale greenish-yellow basal cellular tissue.

2. *Major* form (*a*). Spermogones externally resembling those already described, save that they are grouped by themselves outside the region occupied by the apothecia. Spermatia, however, very different, though also in myriads; atomic, linear, ellipsoid, ·0001″ long, ·00005″ broad, seated on simple, linear-conoid sterigmata, about ·00015″ long.

Sp. 2. V. NITIDA, Schrad.

On trunks of living trees, Greenisland bush, Otago: W. L. L. Thallus coarsely verrucose, brownish yellow, resembling the very rugose thallus of some *Pertusariæ*. Apothecia large, scattered or confluent, frequently irregular or difform, sometimes maculæform, occasionally cæsio-pruinose, seated equally on the depressions and elevations of a thallus which follows closely all the rugæ and fissures of old cracked tree-barks. In a specimen in herbarium Kew, on the bark of *Mangifera Indica*, Mauritius, the thallus is vermilion-red, and the spores olive, ·0008″ long, ·0003″ broad.

Var. *nitidella*, Flk.

On the trunks of trees, Martin's bush, Chain-hills, Otago: W. L. L. Thallus smooth, but of the same brownish-yellow hue as in the type. Apothecia smaller and more regular in form than in the type, frequently with a distinct black-punctate ostiole girt by a paler or whitish ring, sometimes confluent, and then subdifform. In British specimens in herbarium Kew, from Turner, the apothecia are also more abundant and crowded, and much smaller than in the type, the spores, however, being the same—·0008″ to ·0010″ long, ·0003″ broad.

Sp. 3. V. EPIDERMIDIS, Ach., var. *punctiformis*, Ach.

On twigs of shrubs, head of Otago harbour, associated with *Physcia chrysophthalma* &c. In specimens of the type in herbarium Kew (sub nom. *V. stigmatella*, Ach., and *V. analepta*, Ach.: on young oaks, St. Leonard's Forest), and also in various Irish and Scotch specimens, the spores are soleæform, pale yellow, ·0008″ long, 0003″ broad; and thecæ ·0035″ long, ·0006″ broad.

The following other British species occur in Otago:—

Sp. 4. V. PALLIDA, Ach. [*Dermatocarpon*, Mudd, Manual, 269.]

In crevices of mica-slate, Glen Martin, Chain-hills: W. L. L. Has the external appearance of *Endocarpon pusillum*, Hedw., as a variety of which Fries regarded it (Lich. Ref. 411).

Sp. 5. V. MAURA, Wahl.

On slaty traps, rocky coast about the Nuggets and Shaw's Bay, coating the rocks exposed to the sea-spray (or occasionally covered by the tides) with black oil-like stains, precisely as on the eastern coast of Scotland.

All the *Verrucariæ* recorded in the 'Flora Novæ Zelandiæ' are given as *North* Island species, evidently because, when the work in question was issued, equal attention had not been given to the collection and examination of the more minute and obscure corticolous and saxicolous lichens of the *south* island. There can be no doubt that, so soon as *local* botanists can give adequate care and time to the collection of these groups of the lower lichens, important additions will be made to the number of the New-Zealand *Verrucariæ*, including, in all probability, species which are British, or cosmopolite, or have otherwise a wide geographical range. Since the publication of Babington's list (Lich. N. Z. in Fl. N. Z.), Dr. Knight * has added several *Verrucariæ* from the province of Auckland to the lichen-flora of New Zealand; and similar additions are likely to attend the efforts of local collectors in all parts of the colony, if they bestow a similar amount of care and time on the subject.

DESCRIPTION OF PLATES.

PLATE LX.

Figs. 1 to 5. *Sticta fossulata*, Duf., and its varieties.

1. Otago. Spores: *a*, younger; *b*, older.
2. Wellington. Spores: *a*, younger; *b*, older.
3. Var. *Richardi*, Mont.: Otago. Spores: *a*, younger; *b*, older.
4. *S. impressa*, Tayl., pr. p.: Auckland (Antarctic Expedition). Section of hymenium: *a*, paraphyses; *b*, theca; *c*, hypothecium; *d*, spores.
5. Var. *linearis*, Tayl. (*S. impressa*, Tayl., pr. p.): Auckland (Antarctic Expedition). Spores: *a*, younger; *b*, older; *c*, in process of germination.

Fig. 6. *S. physciospora*, Nyl.: Otago. Spores: *a*, younger; *b*, older; *c*, beginning to germinate.

Figs. 7–10. *S. orygmæa*, Ach.

7. Otago. Spores: *a*, younger; *b*, mature; *c*, older.
8. Chatham Islands. Sterigmata and spermatia.
9. Auckland Islands: *a*, theca; *b* and *c*, spores (*b*, young; *c*, mature).
10. *S. flava*, Hook. fil.: Auckland (Antarctic Expedition). Spores: *a*, mature; *b*, preparing to germinate.

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* "On some New-Zealand *Verrucariæ*" (mostly corticolous species), with figures—Trans. Linn. Soc. vol. xxiii. p. 99, plate XI.

Figs. 11–13. *S. Urvillei*, Dél., and its varieties.

11. Otago. Spores: *a*, mature; *b*, old; *c*, preparing to germinate.

12. Var. *flavicans*, Hook.: Chatham Islands. *a* and *b*, spores (*a*, young; *b*, mature); *c*, tip of paraphyses.

13. Hermite Island. Sterigmata and Spermatia.

Fig. 14. *S. dissimulata*, Nyl., var. *multifida*, Laur.: Otago. Section of hymenium: *a*, epithecial membrane; *b*, paraphyses; *c* and *d*, thecæ (*d*, under influence of iodine); *e*, hypothecium; *f*, spores, young and mature.

Fig. 15. *S. aurata*, Ach.: Brazil. Spores: young, mature, and old.

Fig. 16. *S. latifrons*, Rich.: Otago. Spores: *a*, young; *b*, mature; *c*, old, in process of germination.

Fig. 17. *S. damæcornis*, Ach.: Java. Spores: young and mature.

Fig. 18. *S. Freycinetii*, Dél. (*S. glabra*, Tayl.): Falkland Islands. *a*, theca; *b*, spore, mature; *c*, sterigmata and spermatia.

Fig. 19. *S. granulata*, Bab.: Otago. Spores: *a*, young; *b*, mature.

Figs. 20, 21. *Stictina crocata*, L.

20. Swan River (Australia). Spores: young and mature.

21. North America. Spores: young and mature.

Fig. 22. *S. fuliginosa*, Dicks.: Tavistock (England). Spores: young and mature.

Fig. 23. *Ricasolia coriacea*, Hook. & Tayl: Otago. Spores: *a*, young; *b*, mature; *c*, old.

Fig. 24. *R. herbacea*, Huds.: Inverary (Scotland). *a*, theca; *b*, spores—young, mature, and old.

Fig. 25. *Celidium Pelvetii*, Hepp, parasitic on *Sticta aurata*, Ach., Hepp. Exs. 589: France. *a*, theca under action of iodine; *b*, spores, young and mature.

Figs. 26, 27. *C. stictarum*, Tul.

26. On apothecia of *Sticta pulmonacea*, Ach., Nyl. Exs.: France. *a*, theca under action of iodine; *b*, *c*, *d*, spores (*b*, young; *c*, mature; *d*, old, in process of germination).

27. On apothecia of same *Sticta*, Schærer, Exs. 350: Switzerland. Spores: *a*, mature; *b*, old.

Fig. 28. *Abrothallus Smithii*, Tul., var. *microspermus*, Tul., on *Stictina fuliginosa*, Dicks., Portugal; and *Stictina limbata*, Sm., Wales. Spores: young and mature.

Fig. 29. *Sticta laciniata*, Ach.: Xalapa (Mexico). Spores: young and mature.

Fig. 30. *Ricasolia discolor*, Dél.: Mucross (Ireland). Spore: mature.

Fig. 31. *R. corrosa*, Ach.: Scotland? Spore: mature.

Nos. 28, 29, 30, and 31 are in herbarium Kew; No. 24, in Author's herbarium.

Plate LXI.

Figs. 1, 2. *Parmelia megaleia*, Nyl.

1. Nepal. Spores: *a*, young; *b*, mature.

2. Sikkim. Spores: *a*, under iodine.

Fig. 3. *P. perlata*, Ach.: Brazil. Spores: *a*, young; *b*, mature; *c*, old.

Figs. 4, 5. *P. pertusa*, Schrank.

4. Otago. *a*, theca; *b* and *c*, spores (*b*, young and mature; *c*, old).

5. Ballahulish (Scotland). Theca.

Fig. 6. *P. physodes*, Ach., var. *enteromorpha*, Ach.: Tasmania. Section of hymenium: *a*, paraphyses; *b*, theca under iodine; *c*, hypothecium; *d*, spores, young and mature.

Fig. 7. *P. lævigata*, Ach., var. *revoluta*, Flk. Otago: *a*, sterigmata and spermatia. Auckland, N. Z.: *b–e*, section of hymenium: *b*, epithecial membrane; *c*, tips of paraphyses under iodine; *d*, thecæ under iodine; *e*, hypothecium; (*c*, *d*, *e*, show action of iodine on the hymenial Lichenine;) *f*, *g*, *h*, spores (*f*, young; *g*, mature; *h*, old).

Fig. 8. *P. conspersa,* Ach.: Otago. Spores: *a,* young; *b,* mature; *c,* old.

Fig. 9. *P. caperata,* Ach.: Otago. Sterigmata and spermatia.

Fig. 10. *Physcia chrysophthalma,* L.: Otago. Spores, young and mature.

Fig. 11. *P. parietina,* De N.: Otago. *a,* theca; *b,* head of one of the paraphyses.

Fig. 12. *P. stellaris,* Fr., form *radiata,* Ach.: Otago. Spores: *a,* young; *b,* mature.

Fig. 13. *Nephroma antarcticum,* Jacq., var. *tenue,* Nyl.: Otago. *a* and *b,* spores (*a,* young; *b,* mature); *c,* spermatia.

Fig. 14. *N. arcticum,* Fr. Spores: *a,* young; *b,* mature.

Fig. 15. *Peltigera rufescens,* Hffm.: Otago. *a,* theca under iodine; *b,* spore, mature.

Fig. 16. *Ramalina calicaris,* Ach.; Otago. Spores: *a,* young; *b,* mature.

Figs. 17, 18. *R. calicaris,* Ach., var. *Eckloni,* Spr.

17. Portugal. *a,* theca under iodine; *b,* spores, mature.

18. Mauritius. Spore, mature.

Fig. 19. *R. calicaris,* Ach., var. *linearis,* Sw.: Mexico. Spores, young and mature.

Fig. 20. *R. scopulorum,* Ach.: Chatham Islands. Spores: *a,* young; *b,* mature; *c,* old.

Fig. 21. *R. scopulorum,* Ach., var. *sepiacea,* Pers.: Cape Horn. Spores, young and mature.

Figs. 22, 23. *Usnea barbata,* Fr., var. *ceratina,* Ach.

22. Rio Janeiro. *a,* theca; *b* and *c,* spores (*b,* young; *c,* mature); *d, e, f,* section of hymenium in another specimen (*d,* paraphyses; *e,* thecæ under iodine; *f,* hypothecium).

23. Jamaica. Spore, mature.

Figs. 24, 25. *U. barbata,* Fr., var. *florida,* L.

24. Otago. *a,* theca; *b, c, d,* spores (*b,* young; *c,* mature; *d,* old).

25. Tasmania. Section of hymenium: *a,* paraphyses; *b,* theca; *c,* hypothecium; *d* and *e,* spores (*d,* young; *e,* mature.)

Fig. 26. *U. angulata,* Ach.: Ceylon. Spores, young and mature.

Figs. 27, 28. *Neuropogon melaxanthus,* Ach.

27. Nelson, N. Z. (var. *ciliatus,* Nyl.). *a, b, c,* spores (*a,* young; *b,* mature; *c,* old); *d* and *e,* spermatia (*d,* full-sized; *e,* half-sized).

28. Hermite Island, and the Falkland Islands. Section of hymenium: *a* and *b,* tips of paraphyses; *c,* hypothecium; (*b* and *c,* show action of iodine on hymenium in some specimens;) *d,* theca under iodine; *e,* oil-globules; *f, g, h,* spores (*f,* young; *g,* mature; *h,* old).

Figs. 29, 30. *Usnea barbata,* Fr., var. *ceratina,* Ach. Portions of branchlets affected by the parasitic *Phymatopsis dubia,* Linds.

29. Switzerland (Hepp. Exs. 561).

30. Tasmania.

Figs. 31, 32. Parasites on the thallus of forms of *U. barbata,* Fr. (*Phymatopsis dubia,* Linds).

31. Rio Janeiro. Spores: *a,* young; *b,* mature.

32. Mauritius: on var. *plicata,* Fr. Spores: *a,* of the *Usnea,* simply discoloured; *b,* of the parasite.

Figs. 33–35. *Ramalina calicaris,* Fr., var. *fraxinea,* Fr.

33. Teneriffe. Spore: mature.

34. Brazil. Spores: mature and old.

35. Chili (Coquimbo). Spores: young and mature.

Fig. 36. *R. pusilla,* Le Prév.: Portugal. Spores: young and mature.

Fig. 37. *Abrothallus Curreyi,* Linds., var. Parasitic on the thallus of *Parmelia lævigata,* Ach., var. *sinuosa,* Sm. Spores: young and mature.

Fig. 38. *A. Smithii,* Tul., var. *microspermus,* Tul. Parasitic on thallus of *Parmelia perlata,* Ach.: Abyssinia. Spores: young and mature.

Fig. 39. *Leptogium bullatum,* Ach. *a* and *b,* Jamaica; *c,* Brazil. Spores: *a,* young; *b,* mature; *c,* old.

Fig. 40. *Usnea longissima,* Ach.: North America (U. S.). Spores, young and mature.

Fig. 41. *U. Jamaicensis,* Ach.: Jamaica. Spore, young.

Fig. 42. *Parmelia lævigata,* Ach., var. *sinuosa,* Sm.: Ireland (Dunkerron). Spores, young.

Fig. 43. *Ramalina scopulorum,* Ach.: Scotland (St. Skae). Spores, young and mature.

Fig. 44. *Usnea barbata,* Fr., var. *hirta,* Fr.: Tasmania. Spores, young and mature.

PLATE LXII.

Fig. 1. *Stereocaulon ramulosum,* Ach.: Tasmania. Section of hymenium: *a,* paraphyses; *b,* theca under iodine; *c,* hypothecium; *d* and *e,* spores (*d,* young; *e,* mature).

Fig. 2. *S. ramulosum,* Ach., var. *macrocarpum,* Bab.: Campbell's Island. Section of hymenium: *a,* paraphyses; *b,* theca; *c,* hypothecium; *d,* oil-globules; *e–h,* spores (*e,* young; *f,* mature; *g,* old; *h,* half-spores).

Fig. 3. *S. macrocarpoides,* Nyl.: Wellington and Auckland, N. Z. *a,* heads of paraphyses; *b,* sterigmata and spermatia; *c* and *d,* spores (*c,* young; *d,* mature).

Fig. 4. *Sphærophoron tenerum,* Laur.: Auckland Islands. Spores *a,* young; *b,* mature.

Figs. 5–7. *S. compressum,* Ach.

5. Auckland, N. Z. (Antarctic Expedition). Portions of thallus, showing the spermogones (*a*) variously viewed and magnified.

6. Otago. Spores: *a,* young; *b,* mature.

7. Ireland. Spores: *a,* young; *b,* old; *c,* nucleus (or endospore).

Fig. 8. *Bæomyces fungoides,* Ach.: Nelson, N. Z. *a,* theca under iodine; *b,* spore, mature.

Fig. 9. *Cladonia aggregata,* Eschw.: Falkland Islands. *a–c,* section of hymenium (*a,* paraphyses; *b,* theca under iodine; *c,* hypothecium); *d,* portion of thallus (podetia) showing the terminal spermogones.

Fig. 10. *C. degenerans,* Flk.: Otago. Spores, mature.

Fig. 11. *Pannaria leucosticta,* Tuck.: Otago. Spores—young, mature, and old.

Figs. 12–14. *Psoroma sphinctrinum,* Mnt.

12. Otago. *a, b, c,* thecæ (*a–c,* under iodine; *a,* young; *b, c,* mature); *d–f,* spores (*d,* young; *e,* mature; *f,* old).

13. Auckland Islands: *a,* theca; *b,* spores.

14. Mauritius. Spores.

Fig. 15. *Squamaria galactina,* Ach.: Otago. Spores—young, mature, and old.

Fig. 16. *S. galactina,* Ach., var. *dispersa,* Pers.: Otago. Spores, young and mature.

Fig. 17. *Lecanora chrysosticta,* Tayl.: Otago. *a* and *b,* thecæ under iodine (*a,* young; *b,* mature); *c* and *d,* spores (*c,* mature; *d,* old).

Figs. 18, 19. *L. punicea,* Ach.

18. Otago. Spores: *a,* young; *b,* mature.

19. Java. Spores, young and mature.

Fig. 20. *L. aurantiaca,* Ach., var. *erythrella,* Ach.: Otago. Spores: *a,* young; *b,* mature.

Fig. 21. *L. vitellina,* Ach.: Otago. Spores, young and mature.

Fig. 22. *L. pyracea,* Ach.: Otago. Spores, mature.

Fig. 23. *L. umbrina,* Ehrh.: Otago. *a* and *b,* spores (*a,* young; *b,* mature); *c, d, e,* basidia and stylospores (*e,* under iodine).

Fig. 24. *L. subfusca,* Ach., var. *epibrya,* Ach.: Otago. Spores, young and mature.

Fig. 25. *L. atra,* Ach.: Otago. Spores, young and mature.

Figs. 26, 27. *L. cinerea,* L.

26. Otago. Spores: *a,* young; *b,* mature.

27. Sweden. Spores, young and old.

Fig. 28. *L. parella,* Ach.: New South Wales. *a,* theca under iodine; *b* and *c,* spores (*b,* mature; *c,* old).

Fig. 29. *L. simplex,* Dav.: Wales. Apothecia, mature.

Fig. 30. *Urceolaria scruposa,* Ach.: Otago. Spores, young and mature.

Fig. 31. *U. stictica,* Körb.: Otago. *a,* theca; *b,* spore: mature.

Fig. 32. *Dirina repanda,* Fr.: Algeria. Spore, mature.

Fig. 33. *Lecanora aurantiaca,* Ach., var. *erythrella,* Ach.: France [Nyl. Exs.]. Young spores.

Fig. 34. *Physcia flavicans,* DC., var. *exilis,* Mich.: Java. Spore, mature.

Fig. 35. *Urceolaria scruposa,* Ach., var. *bryophila,* Ach.: France (Dauphiné). Spores, young.

Fig. 36. *Lecanora cinerea,* L.: British. Spore.

Fig. 37. *L. aurantiaca,* Ach., var. *ochracea,* Fr.: Wales. Spores, old.

Fig. 38. *L. aurantiaca,* Ach.: British typical forms. Spores, mature.

Fig. 39. *Bæomyces fungoides,* Ach.: Germany. Spores, mature.

Plate LXIII.

Fig. 1. *Pertusaria communis,* DC.: Otago. *a–c,* spores (*a,* young; *b* and *c,* mature).

Fig. 2. *P. velata,* Turn.: Otago. Spores: *a,* young; *b,* mature.

Fig. 3. *Thelotrema lepadinum,* Ach.: Otago. Spores: *a,* young; *b,* mature.

Fig. 4. *T. monosporum,* Nyl.: Otago. *a–c,* section of hymenium (*a,* paraphyses; *b,* thecæ; *c,* hypothecium); *d* and *e,* spores (*d,* young; *e,* mature).

Fig. 5. *Cœnogonium implexum,* Nyl.: Otago. *a–c,* section of hymenium (*a,* heads of paraphyses; *b,* theca; *c,* hypothecium): *b* and *d,* show different reaction of iodine on hymenial lichenine in different specimens; *e,* spores, mature; *f,* filaments or tubules of thallus.

Fig. 6. *Lecidea pineti,* Ach.: Otago. Spores: *a,* young; *b,* mature.

Fig. 7. *L. arceutina,* Ach.: Otago. *a–d,* section of hymenium: *a,* heads of paraphyses; *b,* theca under iodine; *c,* oil-globules; *d,* hypothecium. *b, c, d* also show the reaction of iodine on the hymenium. *e* and *f,* spores (*e,* young; *f,* mature); *g,* sterigmata and spermatia.

Fig. 8. *L. pulverea,* Borr.: Otago. Spore, young.

Fig. 9. *L. pulverea,* Borr., var. *Lauro-cerasi,* Dél.: Otago. Spores, young and mature.

Fig. 10. *L. sabuletorum,* Flk.: Otago. Spore, mature.

Fig. 11. *L. furfuracea,* Pers.: Otago. Spores, mature.

Fig. 12. *L. marginiflexa,* Tayl.: Otago. Spores: *a,* young; *b,* mature; *c,* old; *d,* half-spore; *e,* oil-globules.

Figs. 13–15. *L. grossa,* Pers.

13. Otago. *a–c,* section of hymenium (*a,* paraphyses; *b,* thecæ under iodine; *c,* hypothecium: *b* and *c* also show action of iodine on hymenium); *d* and *e,* spores (*d,* mature; *e,* old).

14. Rio Janeiro. *a,* theca under iodine; *b, c, d,* spores (*b,* young; *c* and *d,* mature; *d,* under iodine).

15. Scotland. Spore, mature.

Figs. 16, 17. *L. disciformis,* Fr.

16. Otago. Spores: *a,* young; b, mature; *c,* old.

17. New South Wales. Spores: *a,* young; *b,* mature; *c,* old.

Figs. 18, 19. *L. myriocarpa,* DC.

18. Otago: Spores: *a,* young; *b,* mature; *c,* old.

19. England. Spores, mature.

Fig. 20. *L. stellulata,* Tayl.: Otago. Spores, young and mature.

Fig. 21. *L. petræa,* Flot.: Otago. Spores: *a,* young; *b,* mature; *c,* old.

Fig. 22. *L. parasema,* Ach.: Otago. Spores—young, mature, and old.

Fig. 23. *L. parasema,* Ach., var. *latypea,* Ach.: Otago. Spores: *a,* young; *b,* mature; *c,* old.

Fig. 24. *L. parasema,* Ach., var. *enteroleuca,* Ach.: Otago. Spores, young and mature.

Fig. 25. *L. contigua,* Fr., var. *crustulata,* Ach.: Otago. Spores—young, mature, and old.

Fig. 26. *L. contigua,* Fr., var. *meiospora,* Nyl.: Auckland. *a,* theca under iodine; *b* and *c,* spores (*b,* mature; *c,* old).

Fig. 27. *L. lapicida,* Fr., var. *declinans,* Nyl.: Otago. Spores, young and mature.

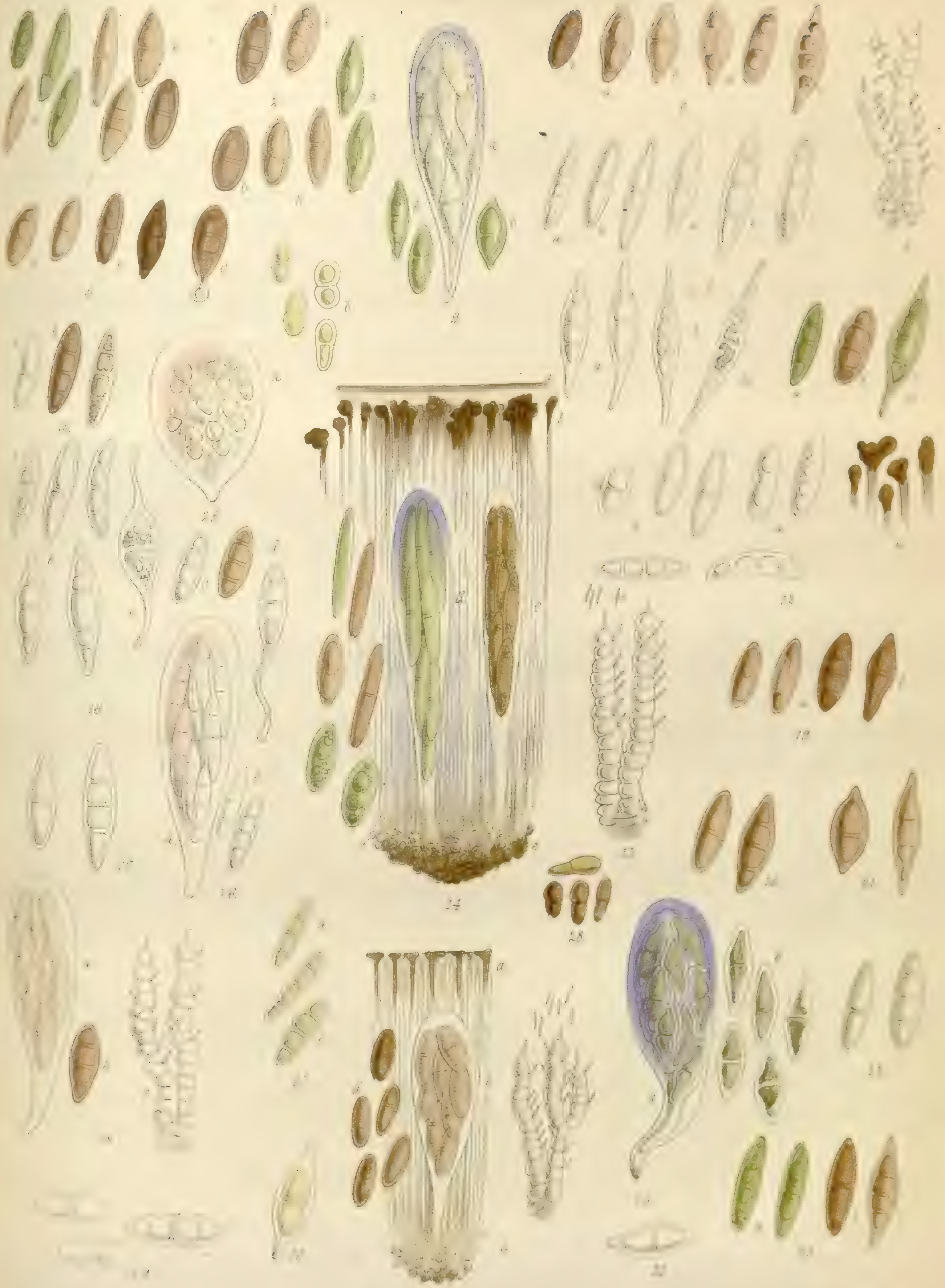
Fig. 28. *Arthonia excedens,* Nyl.: Otago. *a,* theca; *b–d,* spores (*b,* young; *c,* mature; *d,* old).

Fig. 29. *A. conspicua,* Nyl.: Auckland, N.Z. *a,* apothecium; *b,* spore.

Fig. 30. *Verrucaria glabrata,* Ach.: Otago. *a* and *b,* sterigmata and spermatia: *a,* major forms; *b,* minor forms.

Fig. 31. *Lecidea cinnabarina,* Fr.: Auckland, N.Z. Spores, mature.

Fig. 32. *L. pyrophthalma,* Mont.: Auckland, N. Z. Spores, mature.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W. L. Lindsay del. Fitch, lith.

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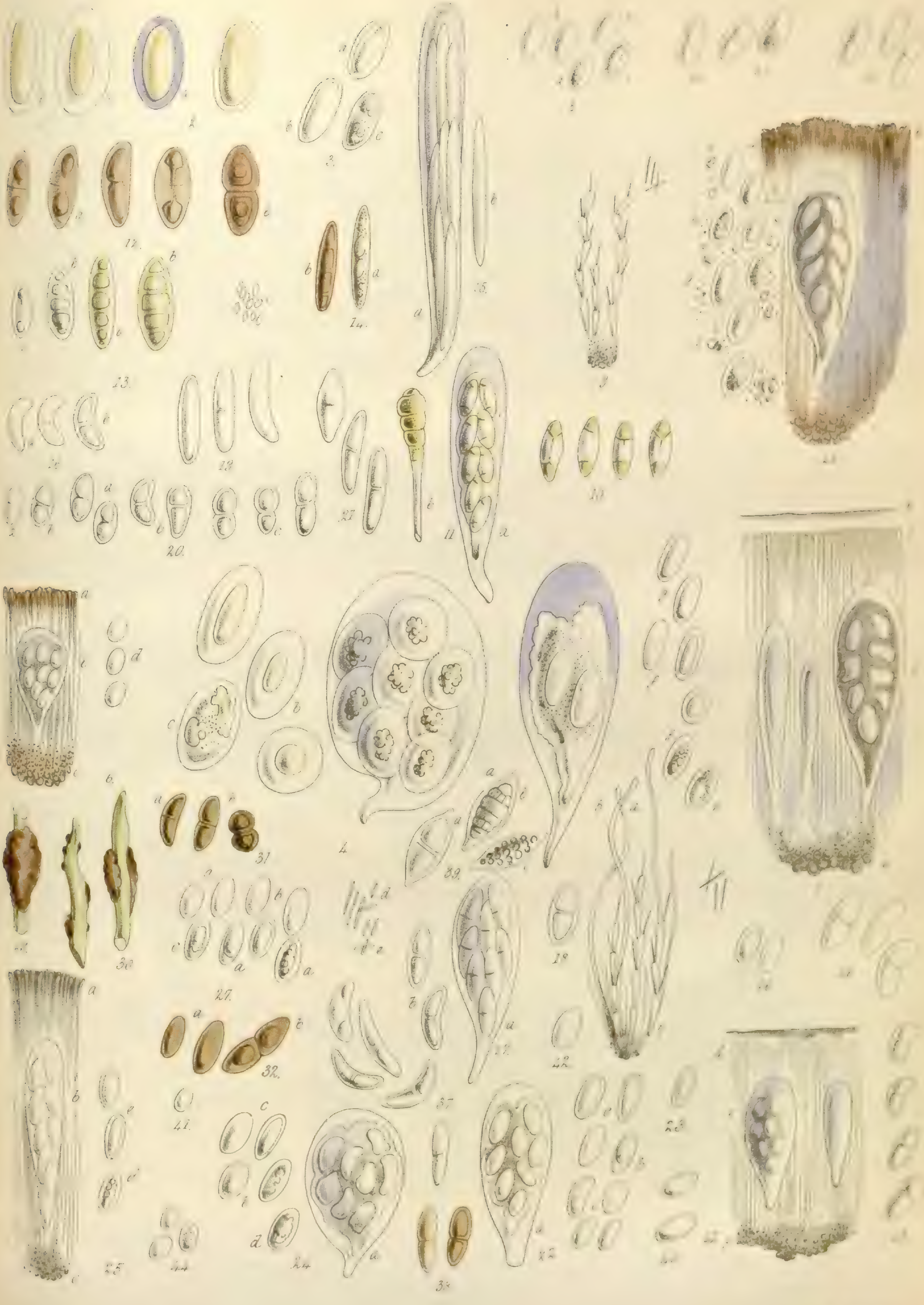
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W. L. Lindsay del. W. Fitch lith.

J. N. Fitch Imp.

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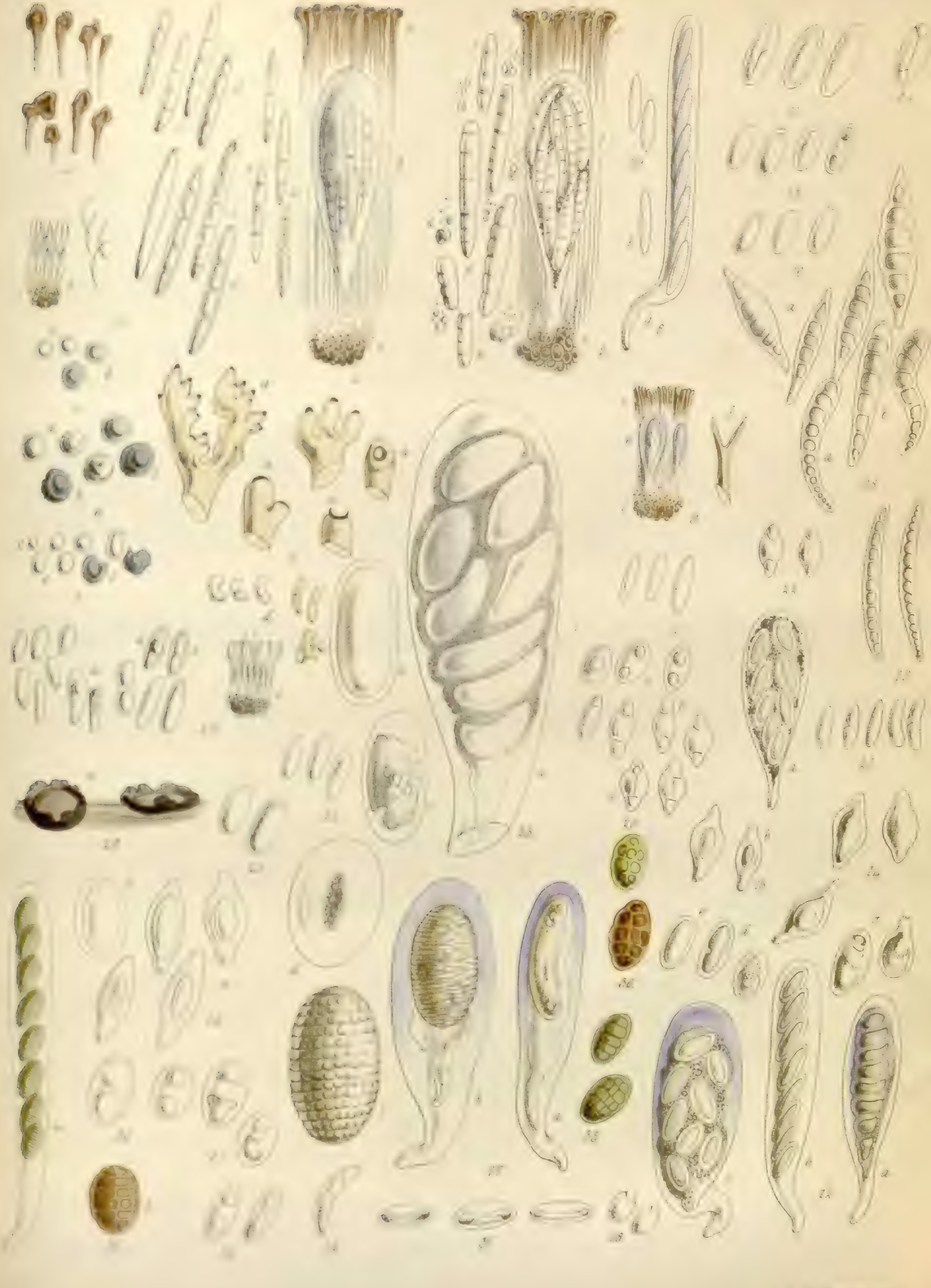

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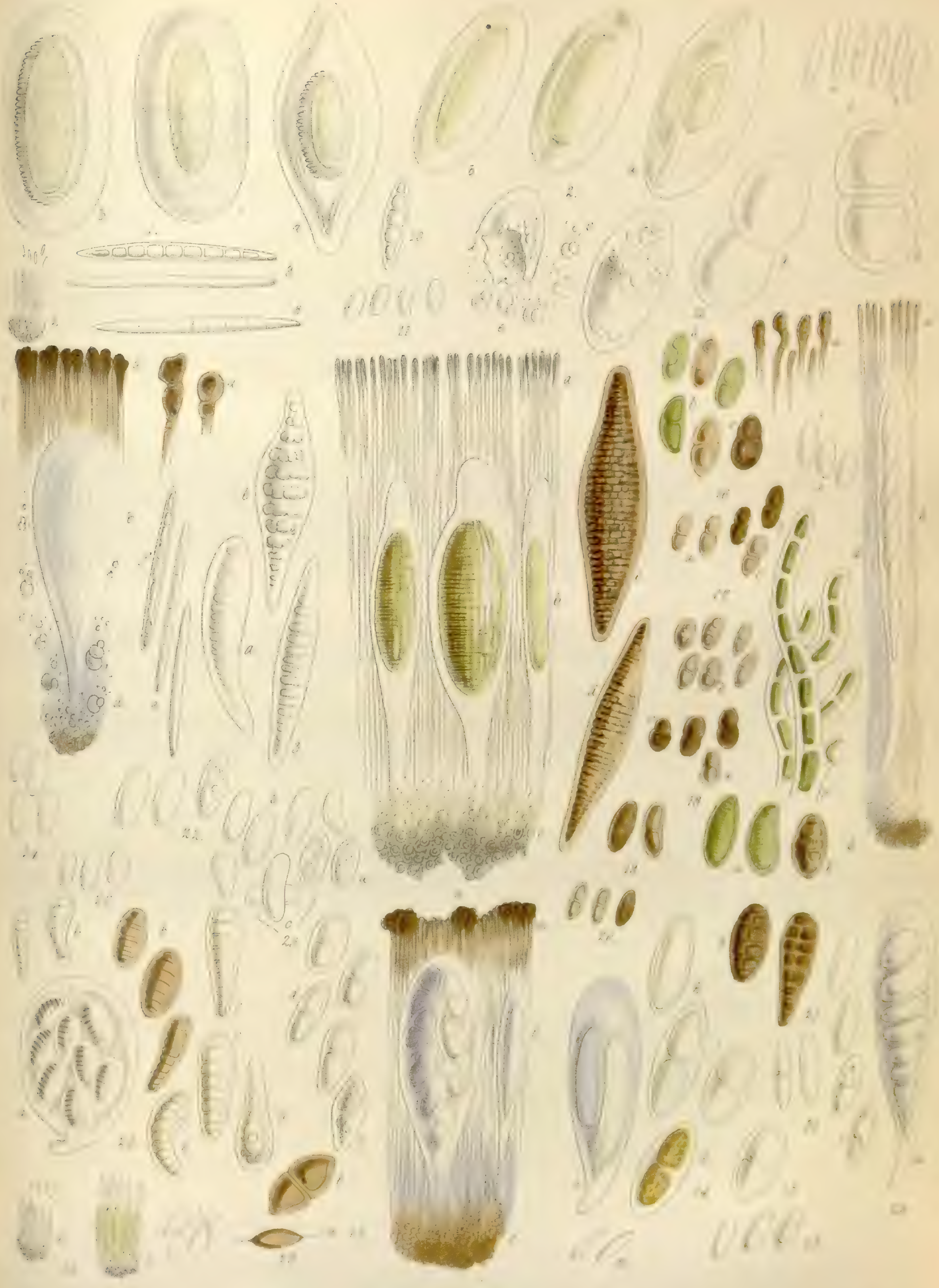

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XXI. *Contributions to a Natural History of the* Teredidæ. *By* E. Perceval Wright, *M.D., A.M., Professor of Zoology, University of Dublin, F.L.S., F.Z.S.*

(Plates LXIV. & LXV.)

Read April 5th 1866.

THE genus *Kuphus* was established nearly a century ago by Guettard, for the *Serpula arenaria* of Linnæus; but nothing would appear to have been known about the animal forming the shelly tubes until some years later, when Mr. Griffiths favoured Sir Joseph Banks with an account of a large number of specimens taken on the shore of the low island of Battoo, about twenty leagues distant from the coast of Sumatra, after a severe earthquake which occurred there in 1797. These were described * as found sticking out some 8 or 10 inches from the hard mud, and covered by from one to three fathoms of water; one specimen measured 5 feet 4 inches in length, and 9 inches in circumference at its tail. The animal was not observed, further than that it protruded, from the two apertures at the apex of the shell, tentacula resembling small actiniæ.

In the same volume of the Philosophical Transactions there is a paper by Sir Everard Home, "On the Shell of the Sea-worm from the Coast of Sumatra, proving it to belong to a species of *Teredo*." Sir Joseph Banks believed it to be a *Teredo*; and this opinion, Sir Everard Home says, was confirmed by the discovery of the two recent valves, and the two flattened opercula *inclosed* in one of the specimens.

The entire of the paper, however, is taken up with a description of *Teredo navalis* (? *T. norvegica*); and although the palettes figured on plate xii. (figs. 4 & 5), are very fair representatives of those since ascertained to belong to *Kuphus*, yet figure 6, of the recent shell of the *Teredo*, might represent almost anything. While the mere removing of this animal (or at least of its shelly tube) from the Annelida to the Mollusca was a step in the right direction, still another half-century elapsed before anything more was known about its structure or affinities; and for all that we do know of it from that time until the present, we are indebted to the researches of one to whom all naturalists owe very much, Dr. J. E. Gray of the British Museum.

From the examination of an apparently perfectly closed specimen of the shelly tube, Dr. Gray was led to believe that the animal of *Kuphus* was distinguished from all other Lamellibranchiate Mollusca by the absence of true shelly valves; and in the 'Proceedings of the Zoological Society' for 1857, p. 257, he proposed the genus *Furcella* for its reception, with the following amended characters:—

Furcella, Gray.—Animal without any true shelly valves; siphonal palettes distinct, large, apex dilated, transverse, spathulate, with a central midrib and an elongated, slender, cylindrical base.

Tube clavate, irregular, sometimes bent; apex with two tubular siphonal apertures, separated by a broad hard shelly longitudinal dissepiment; base pierced with small scattered perforations; end inclosed by two overlapping convex septa, arising from the sides and completely closing the ends.

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* Philosophical Transactions, 1806, part 1, pp. 269–274, pls. x. and xi.

These arched terminal plates appear to be absorbed before each period of activity, and the end is again closed with similar plates at each period of rest, after a sufficient elongation and enlargement of the tube for the protection of the enlarged animal, which lives sunk in sandy mud on the shores of tropical climates.

These emended characters of Dr. Gray have been adopted by all recent writers on the subject. Thus Messrs. H. and A. Adams, in their important work 'The Genera of Recent Mollusca,' pp. 331–648, regard the genera *Teredo*, Linn., and *Kuphus*, Guettard, as the two genera of the subfamily Teredininæ; and Mr. Tryon, in his elaborate monograph of the family Teredidæ [*], divides the family into three subfamilies:—I. Teredinæ, containing all the recent *Teredines* except *Kuphus*; II. Teredinidæ (fossil), and III. Kuphinæ, this latter characterized as "without valves, tube clavately cylindrical, sunk horizontally in sand, *never penetrating timber*;" and suggests that *Teredina* may indicate a passage from the free and perfect valves of *Teredo*, through its less important valves eventually becoming merely a portion of the tube, to *Kuphus*, where the valves are wanting, or are replaced by the cleft shelly plate which closes the lower end.

Mr. Tryon had very probably, at the time of reading this memoir, not seen a further paper by Dr. Gray in the 'Proceedings of the Zoological Society of London' [†], in which he points out the danger of arriving at conclusions on imperfect premises; for he proceeds to describe two specimens of a large shell-bearing *Teredo* from some of the Dutch colonies of the Indian Ocean, that, so far as its palettes were concerned, bore a very close resemblance to *Furcella* (*Kuphus*). The palettes of these specimens are described as being of precisely the same form and nearly of the same size as those figured [‡] of *Kuphus arenarius*; but instead of having a small tubercle on the middle of the inner side of the dilated head, each palette is produced into an elongated process about half an inch long, which is more slender and oblong at the base, thicker, flattened, and dilated above, and truncated at the top. The valves closely resemble those of *Teredo navalis*, *norvegica*, and others, but are larger. Not wishing to pronounce positively that this animal belongs to the genus *Furcella*, Dr. Gray named it provisionally *T. furcelloides*.

I am inclined to think, on a careful examination of these specimens, that this species of Dr. Gray is the same as, or at least very closely allied to, one described by Dr. A. A. Gould [§] under the name *Teredo thoracites*, from Tavoy, British Burmah, and for which he afterwards made a new genus, *Calobates* [‖]. The palettes are very large and long, stilt-shaped; the style long and subulate, slightly flexuous, bony, surrounded by a broad dilatation or step, concave on one side and convex on the other, its upper surface deeply excavated; on this is placed the blade, which is three-fourths as long as the style, thin, linear, oblique, truncated at the tips, about one-third the width of the step.

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[*] Proceedings of the Academy of Natural Sciences of Philadelphia, 1862, pp. 453–482.

[†] 1861, p. 313.

[‡] Proceedings of the Zoological Society, 1857, (Mollusca), plate xxxix. fig. 3.

[§] Proceedings of the Boston Society of Natural History, vol. vi. no. 6, October 1856, p. 15.

[‖] Tryon, *loc. cit.* p. 473.

Up to the present, then, the question remained thus:—the *Serpula arenaria* of Linnæus was undoubtedly a mollusk, nearly related to the *Teredines*. Sir Everard Home says that in the tube of *S.* (*T.*) *arenaria* both valves and palettes have been discovered; and as Sir Joseph Banks probably saw some of Mr. Griffith's recently collected specimens, there is no reason to suppose that this was not really the case. Palettes undoubtedly belonging to the animal that fabricated the tube have been discovered in it and described by Dr. J. E. Gray. These are identical with those figured by Home; but no valves were found in Dr. Gray's specimen, though it is very hard to see how they could have been overlooked or lost; and lastly, Dr. Gray and Mr. Gould have described two species of *Teredo* which depart in no very striking detail either in appearance or habitat from ordinary well-known ship-worms; and the siphonal palettes of these bear a certain strong resemblance to those known as occurring in *Kuphus*. Dr. Gray's specimens were in spirit, Mr. Gould's apparently dry. The clearing up of this interesting subject is still a thing to look forward to, the chief point to be determined being the peculiarities of the animal inhabiting the tubes of *Kuphus arenarius*:—Is it generically the same as a *Calobates thoracites*, Gould, and *Teredo furcelloides*, Gray, or does it differ from them and agree with *Kuphus mannii*, sp. nov., hereafter described?

Although unable to settle this point, I still hope that the following description of some very well-marked ship-worms may not be without interest; and though I wish to express myself with all proper caution on the subject, I believe that, with the additional evidence thus afforded, I shall eventually prove not very far wrong in retaining *Kuphus* as a distinct genus from *Calobates*.

The following arrangement of the subgeneric forms of *Teredo*, based chiefly on the form of their siphonal palettes, will show my views more clearly.

1. Teredo, Linnæus.

Siphonal palettes simple, oblong, transverse, entire, rarely serrated or toothed. *T. norvegica*, Speng., *T. navalis*, Linn., *T. megotara*, Hanl., *T. excavata*, Lukis, &c.

2. Nausitora, P. Wright.

Siphonal palettes, outer surface convex, covered with thick scale-like striæ, inner flat or slightly concave. *N. dunlopii* (freshwater, India), ? *N. saulii*, spec. nov.

3. Kuphus, Guettard.

Siphonal palettes with apex dilated, transverse, spathulate, with a central midrib and an elongated, slender, cylindrical base. *Siphons free throughout the greater part of their length.* *K. arenarius* (Linn.) ?, *K. mannii*, spec. nov.

4. Calobates, Gould.

Siphonal palettes large, long, stilt-shaped; *siphons adherent, only becoming free at tips.* *C. thoracites*=*Teredo furcelloides*, Gray, *C. australis*, spec. nov.

5. Xylotrya, Leach.

Siphonal palettes elongate, penniform, horny; lateral edges with short filaments, spongy texture. *X. bipinnata*, Turton, *X. fimbriata*, Jeffreys, &c.

6. UPEROTUS, Guettard.

Siphonal palettes spoon-shaped, depressed; area elegantly ribbed, ribs forming teeth on the upper margin, *U. clava* (Gmel.).

CALOBATES AUSTRALIS, spec. nov. (Plate LXIV. figs. 1–5.)

Of this apparently new species but two imperfect specimens exist: they were forwarded to Dr. Bowerbank by Mr. Clifton, from Freemantle, Western Australia, and were consigned by Dr. Bowerbank to the British Museum. On examining them, the strange shape of the palettes at once struck me; and Dr. J. E. Gray, with the greatest kindness, gave me permission to describe them. Unfortunately no valves exist on either of these specimens. The portions remaining are, as represented in fig. 1, about 1½ inch of the lower portion of the animal, with the siphonal tubes and palettes. The siphonal tubes are united to their very tips, and extend, in the spirit specimens, just above the expanded portion of the palettes. The larger tube has a double row of fringe-like tentacles, the smaller a single row, with the tentacles fewer in number. The palettes are situated right and left of the siphons, and, with them, are enclosed in a deep border of the mantle, which forms an almost circular fringe round the base of both; this border splits in two at the back of the smaller siphonal tube, its margin is slightly puckered, and the integument covering it is rugose. The style of the palettes is about ¾ inch long, strong, very sharp-pointed, and connected to the body by four very distinct muscles, which surround it; these muscles are themselves just covered by the fringe of the mantle. The style next expands into a broad dilatation, which is very slightly concave on its inner surface and convex on its outer: its upper surface is deeply excavated; and from this proceeds a blade-like appendage about ½ inch long; this is directed obliquely, and is tuberculated on its external surface. This description must necessarily be incomplete, owing to the specimens being defective; and it is very possible that, on perfect specimens being discovered, it may prove to be only an Australian form of *Calobates thoracites*, Gould; in order to facilitate comparison with which, I append, from Mr. Tryon's monograph, the description of this species, adding a few remarks on the animal taken from the spirit specimen of *Teredo furcelloides* of Dr. Gray, in the British Museum, of which a figure will be found on Plate LXIV.

CALOBATES THORACITES, Gould. (Plate LXIV. figs. 6–12.)

Teredo thoracites, Gould, Bost. Proc. vi. p. 15 (Oct. 1856).
Teredo furcelloides, Gray, Proc. Zool. Soc. 1861, p. 314.
Calobates thoracites, Gould, Bost. Proc. viii. p. 280 (Feb. 1862).

Shell large, solid, length and breath about equal; valves trifoliate; the anterior area large, about equal to the fang-like body, except that it is truncated anteriorly, where it is smooth, shining, and callous. This anterior area is obtusely lance-pointed and sculptured with concentric striæ parallel to its basal edge, and with a few delicate rugæ radiating from the beaks; the fang-like body is large and broad, obtuse at the point, and armed within by a firm rib, terminating in a rounded ivory knob; a strong flattened rib traverses its posterior extremity, running from the junction of the posterior wing above to the point of the fang; anterior to this the fang is grooved parallel to the anterior edge; while posterior to it the grooves take the direction of the inferior edge of the wing, and become gradually more and more recurved towards the points, and are continued on to the ridge. The posterior dorsal wing is very small and lunate, not rising above the beaks, gently arched, scarcely projecting beyond the posterior margin of the fang; its lower margin would correspond with the lower margin of the anterior area if continued; the superior margin is rough and strong, forming a broad area defined by a sharp-crested ridge, and emarginated at the junction of the wing. Hinge-tubercles large, with a hook-shaped process from each, by which the valves are interlocked; the wing is formed by a sharp shell-like ridge, and is smooth and slightly excavated. The cavity of the beak is filled with a spongy calcareous matter, from which issues the delicate and flattened subumbonal process, which presents its flat side to the valve, and at about one-third of its length forms a decided elbow backwards.

Length from before backwards $\frac{5}{8}$ inch, from above downwards a little less.

Palettes very large and long, stilt-shaped; the style long and subulate, slightly flexuous, bony, surrounded by a broad dilatation or step; concave on one side, convex on the other, its upper surface deeply excavated; on this is placed the blade, which is three-fourths as long as the style, thin, linear, obliquely truncated at the tips, about one-third the width of the slit.

Length of style $\frac{7}{10}$, of blade $\frac{4}{10}$ inch. Brought by the Rev. F. Mason and Rev. J. Benjamin from Tavoy.

The animal is 10 inches long; the siphonal tubes are of nearly equal diameter, and are united nearly to their tips, they reach to a little beyond the dilated portions of the palettes. In a dried specimen of palettes received from Mr. H. Adams from Singapore, and which I refer to this species, this same peculiarity is observable.

KUPHUS? MANNII, spec. nov. (Plate LXV. figs. 1–8.)

Valves.—Rather large in proportion to the animal; the so-called "triangular area" is large, quadrilateral; the fang-like body is large and hollowed out; the whole surface is sculptured, the sculpture consisting of a series of transverse equidistant lines, ribbed on their convex surfaces. The "central portion" is very large, broader than long, with a strongly marked concave depression running from the apex to the point. On about two-thirds of its cutting-surface the sculpture is the same as that on the "triangular area;" on the remaining portion the sculpture is indistinct. The "auricle" is scarcely at all developed. The subumbonal blade is broad and curved. There is no accessory plate. Extreme length of valve $\frac{3}{4}$ inch, breadth $\frac{5}{8}$ inch.

Palettes.—The stalk is about $\frac{1}{4}$ of an inch in length, and of the thickness of a strong pin; it is thin and semitransparent, blunt, and of rather an irregular outline. It expands into a broad blade-like portion, which is $\frac{1}{4}$ inch long, and from being of the thickness of the stalk expands into a breadth of $\frac{1}{4}$ inch. The upper surface is hollowed out, and indistinctly divided into two portions; it is flat on the inner, and convex on the outer portion; it is solid and of a dark-brown colour.

This species, which I have ventured to place in the genus *Kuphus*, was taken by Mr. Mann from the western jetty of the Peninsular and Oriental Steamship Company's New Harbour of Singapore, in October 1863. For two of these specimens I am indebted to the liberality of Mr. Weir: one them (*vide* Plate LXV. fig. 1) is quite perfect, and is about 7 inches in length; the valves are about the same size as those of *Teredo norvegica*, the siphonal tubes are separated at their extremities for nearly ½ inch, and when the siphonal palettes are closed are found lying right and left of them.

The siphonal palettes (figs. 5–8) themselves are very different from those met with in *Calobates*. The style is very feebly developed, and scarcely ¼ inch in length: the expanded part is of about the same dimensions as in the previous genus, but there is no trace of the stilt-like portion: it may, of course, have been broken off; but I do not think this is the case. The general appearance of these palettes is like that of *K. arenarius* (figs. 16, 17); but they are of much smaller size, and, while they have all the appearance of belonging to a mature animal, are much more rudimentary than those of *K. arenarius*: the difference in the habitat of the two species may in some measure account for this.

It may be suggested that the palettes of the above-described species, although very closely related to those supposed to belong to *Kuphus arenarius*, resemble also in many details those found in *Calobates thoracites*, Gould (*C. furcelloides*, Gray), and *C. australis* (n. s.), and that, if the long processes were broken off any of the latter, no difference of any importance would be found to exist between them; but it appears to me that the difference in the amount of the attachment of the siphonal tubes is one of some importance. In the well-known tube of *K. arenarius* a shelly division exists at its lower portion, dividing it into two parts—one for the branchial, the other for the exhalant siphon; and this leads one naturally to suppose that the siphonal tubes penetrate some distance into these partitions. Now, in *Calobates thoracites* and *C. australis*, the siphonal tubes are so closely united together, almost to their very tips, that they could not separately occupy two distinct shelly partitions in the one shelly tube; and hence I infer that this structural difference will be represented in the shelly tubes, if present, and will serve to distinguish them from those of the other genus.

If it should be ultimately found that the animal of *K. arenarius* resembles in its general structure that which I have above described as *K.* ? *mannii*, then the question will still remain, Are these differences of sufficient importance to separate these forms into genera or subgenera, or are they only of specific value? Such a question can be decided only by and by, when fresh specimens of all the species shall have been collected and examined.

In the meanwhile, the only forms of siphonal palette at all corresponding to those met with in the tubes of *Kuphus arenarius* that have as yet been discovered are those of the species just described, which also possesses siphonal tubes such as, from the appearance of the shelly tube of *K. arenarius*, we should imagine this latter mollusk to have; so that I fancy the weight of evidence goes towards proving *K. arenarius* to be the tube of a Lamellibranchiate mollusk closely allied to *Kuphus mannii*.

If this be so, we still have the strange and anomalous fact of a *Teredo* living in sand, and forming a large external shelly tube to protect itself against its being overwhelmed by the soft mud—this tube being added to, in all probability, according as the mud rises, and then arched over and covered in so as to serve as a perfect case, the *Teredo* still preserving unmodified its shelly boring valves; while other very closely allied species live in timber, where the same old habit is kept up of having a shelly tube, even in some cases arched over, and oftentimes concamerated, and this tube often attaining almost the dimensions and solidity of the mud-loving form.

Do not these facts seem to indicate that such forms as *K. arenarius* are the older forms, allied to the more typical mud-boring Mollusca through such genera as *Gastrochæna*, *Clavagella*, and *Brechites*, and that gradually, as the *Teredines* became wood-borers, they became somewhat altered, not only in their habits, but in their functions? The shelly tube, no longer a necessity, was more feebly, and then not at all, secreted; and except when the mollusk bored too near to the surface, there would be no occasion for any protection from soft mud and sand, and the tube would seldom if ever be covered in.

I hope, through the kindness of Mr. Weir and of Mr. Mann, to receive specimens of the tubes, if any, secreted by *K.* ? *mannii*, and also recent specimens of *Calobates thoracites*, from Singapore, so that I may be enabled to satisfy myself more completely on some of the points referred to in this paper.

I hardly need here add that the circumstance of these two last-mentioned forms being found living in the timber of the same jetty does not at all imply that they necessarily belong to the same genus or species. It not unfrequently happens that several species of *Teredines* are found boring into one log of timber.

I owe many thanks to Mr. H. Adams for his kindness, not only in lending me specimens of *C. thoracites*, but also for obtaining for me the specimens of *K. mannii*.

NAUSITORA SAULII, spec. nov. (Plate LXV. figs. 9–15.)

The genus *Nausitora* was established for a remarkable freshwater *Teredo* from India. (*Vide* Trans. Linn. Soc. vol. xxiv. p. 451, plate xlvi.) The characters which I thought at the time sufficient to justify me in making a new genus for its reception were the absence of the auricle in the valves, these being bilobed, and the peculiar roughly imbricated blades of the palettes. Since then (January 1864) I have seen four or five additional specimens of this species; and these characters are constant in all. In the new species, however, now under consideration, while the palettes are more closely allied to *Nausitora* than to any other of the genera of the Teredidæ, the valves are furnished with well-developed auricles. Rather than make a new subgenus for its reception, I prefer to slightly modify the generic characters of the genus *Nausitora*, drawing them from the form of the siphonal palettes, rather than from the valves. The characters of this new species may be briefly given as follows:—Valves small, thin, papyraceous, somewhat longer than broad. The "triangular area" is small, obtusely truncated; anteriorly it is shining, the lines of sculpture having broader interspaces than those which are found on the "central portion." This latter is half as broad again as the "triangular area," and a little more than twice as long, ending in a blunt knob. The longitudinal lines of sculpture on one half of this portion are simply a continuation of those on the "triangular area," the transverse lines are better marked; the lines of sculpture gradually approximate, and at last converge to a point at one side of the blunt termination: on the other, or outer half, the sculpture consists of irregular wavy lines, corresponding probably to those of the growth of the shell. The "auricle" is well marked, equalling in size the "triangular area;" it is nearly twice as broad as long, it is gently arched, and the sculpture is the same as that on the outer part of the body portion. The callosity of the hinge-margin is well developed; the subumbonal blade is flat and strongly sickle-shaped. The accessory plate is very feebly developed.

The palettes are about ½ an inch in length. The stalk is short and slender; the blade consists of a number of large, very loosely imbricated scales, arranged in a V-shaped series, one over another, from the apex of the stalk. A central core-like body runs up the blade, which is slightly convex on its outer, somewhat flat on its inner surface.

This pretty and interesting species was presented to the British Museum by Miss Saul, after whom I named it in manuscript in 1862, with Dr. J. E. Gray's permission. The shelly tube is well calcified, like those of many of the timber-boring *Teredines*; these tubes are closed in when the animals have bored either to or too near the surface of the timber. The specimens came from Port Phillip, Australia.

DESCRIPTION OF THE PLATES.

Plate LXIV.

Fig. 1. *Calobates australis.* Portion containing the siphonal tubes and palettes. Natural size.

Fig. 2. Siphonal tubes and palettes. Enlarged.

Fig. 3. Siphonal tubes and palettes. Side view.

Figs. 4, 5. Palettes. Inner and outer view.

Fig. 6. *Calobates thoracites.* Natural size.

Fig. 7. Siphonal tubes and palettes. Enlarged.

Figs. 8, 9, 10. Outer, inner, and side view of palettes.

Fig. 11. Front view of valve.

Fig. 12. View of interior of valve, showing the spongy calcareous growth. The subumbonal blade was unfortunately broken in this specimen before it was given to the artist; but it agreed in every respect with Mr. Gould's description.

Plate LXV.

Fig. 1. *Kuphus mannii,* natural size. (This specimen is about an inch the shorter of the two referred to.)

Fig. 2. Valve, inner surface; and fig. 3, outer surface.

Fig. 4. Sculpture on part of the triangular area and central portion, enlarged.

Fig. 5. Siphonal tubes and palettes, enlarged.

Figs. 6, 7, 8. Outer, inner, and side view of palettes, enlarged.

Fig. 9. *Nausitora saulii.* Valve, outer surface, slightly enlarged.

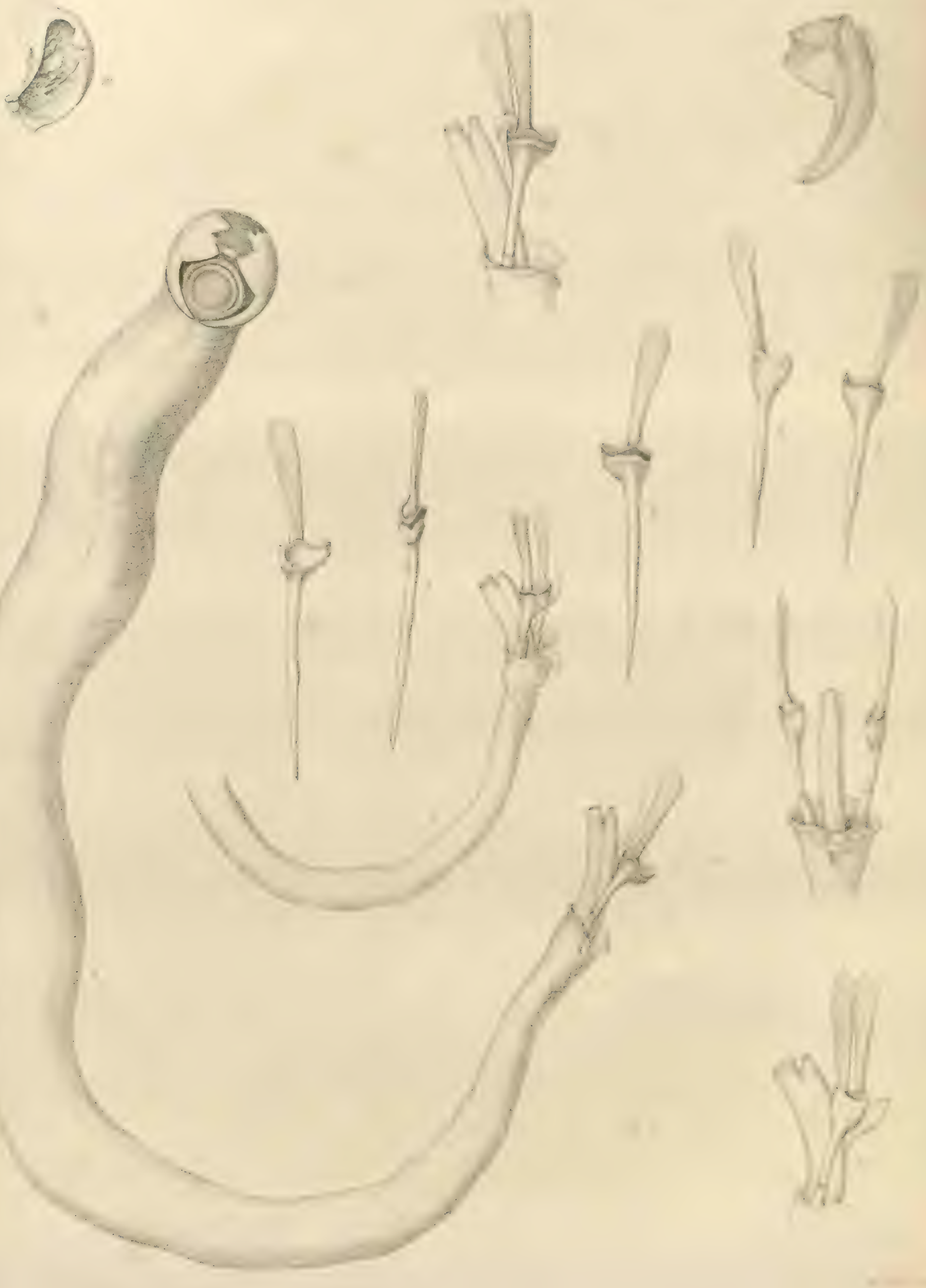
Fig. 10. Valve, inner surface.

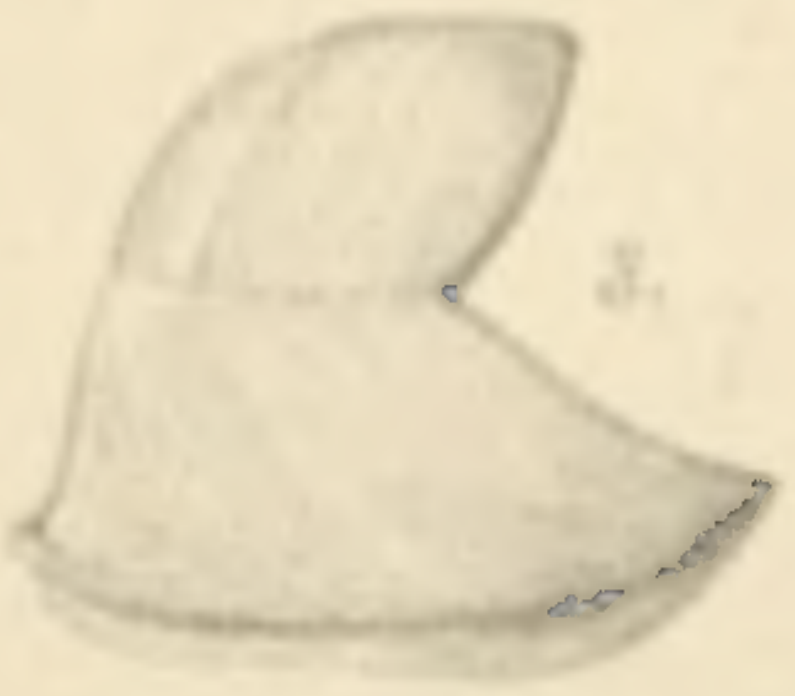
Fig. 11. Sculpture on triangular area.

Fig. 12. Sculpture on central portion.

Figs. 13, 14, 15. Palettes of ditto. Fig. 13, natural size; figs. 14 & 15, outer and inner view of ditto, enlarged; figs. 13′, 14′, 15′, same palettes, much enlarged (inserted by mistake of the artist).

Figs. 16, 17. *Kuphus arenarius* (from Proc. Zool. Soc. 1857, Mollusca, plate xxxix. fig. 3). Palettes natural size.

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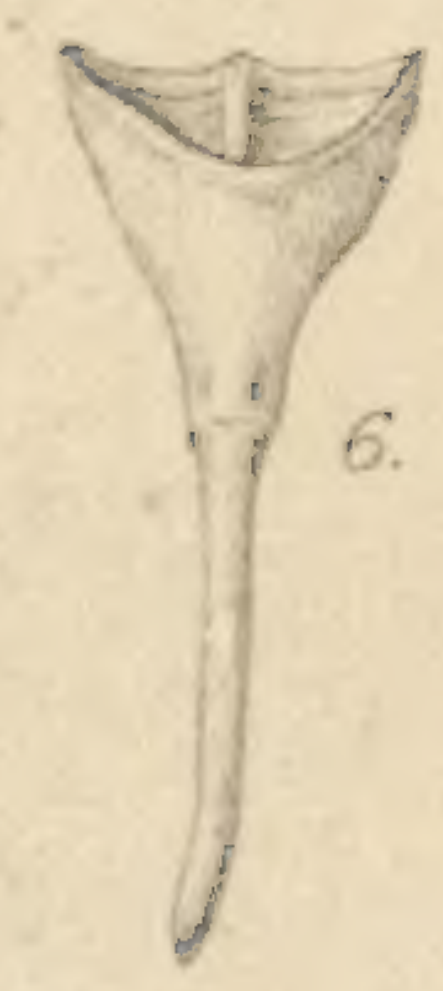
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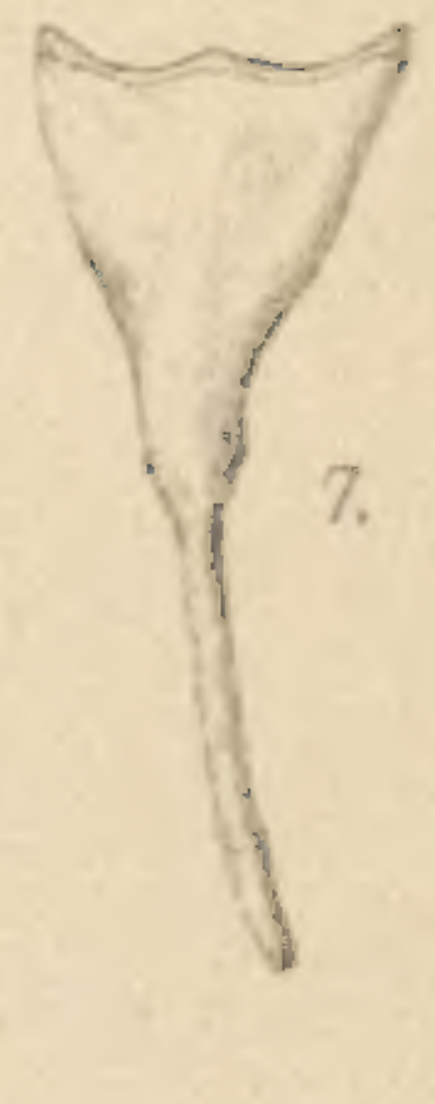
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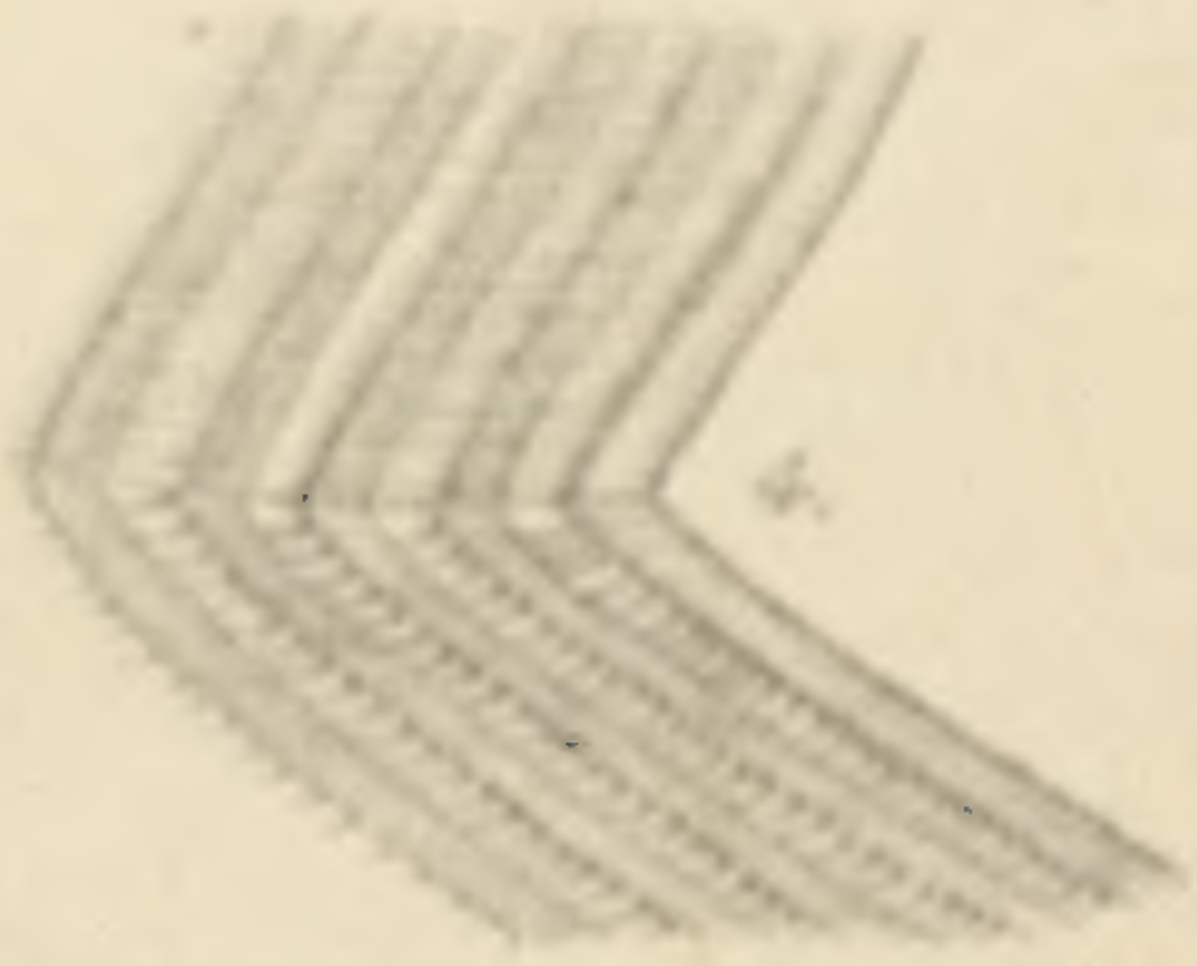
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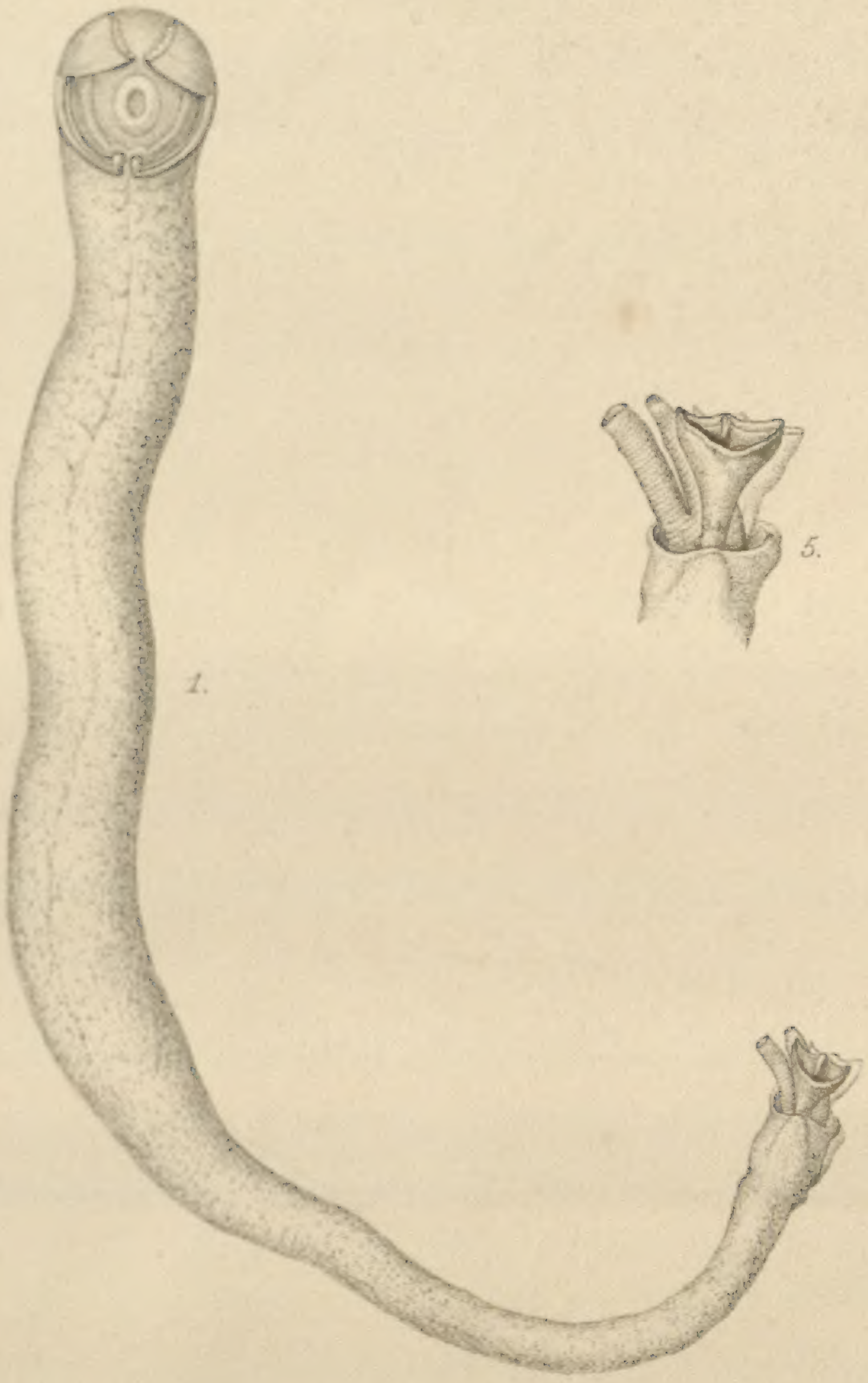
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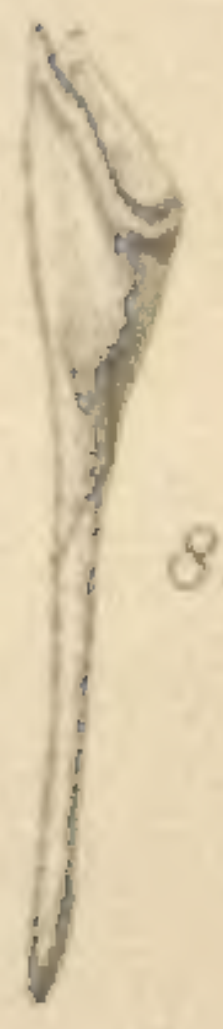
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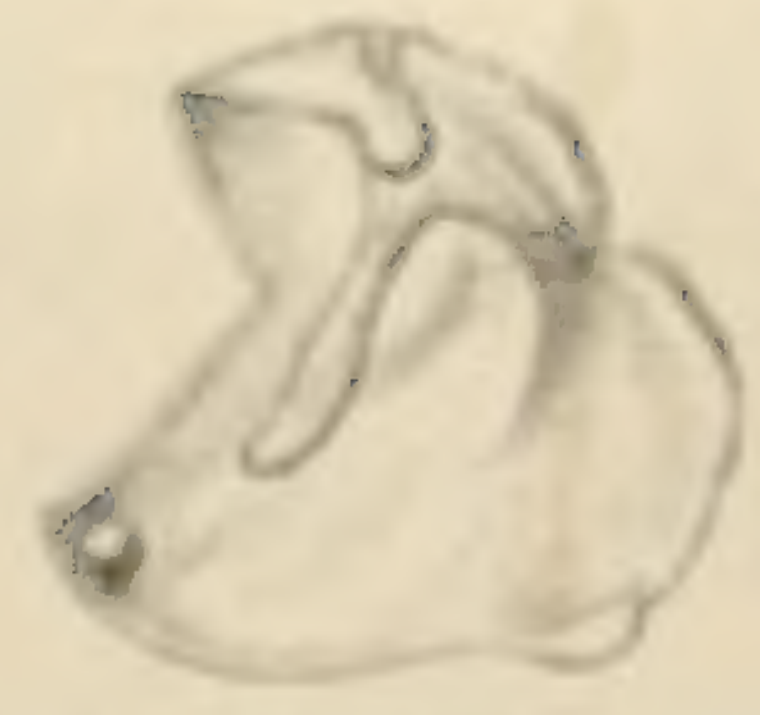
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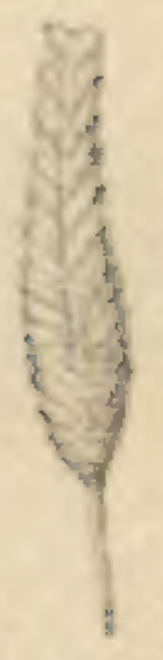
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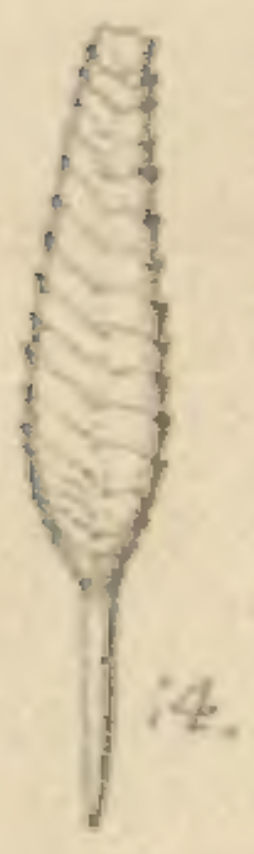
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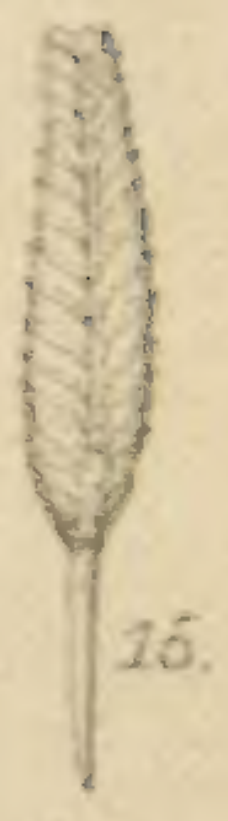
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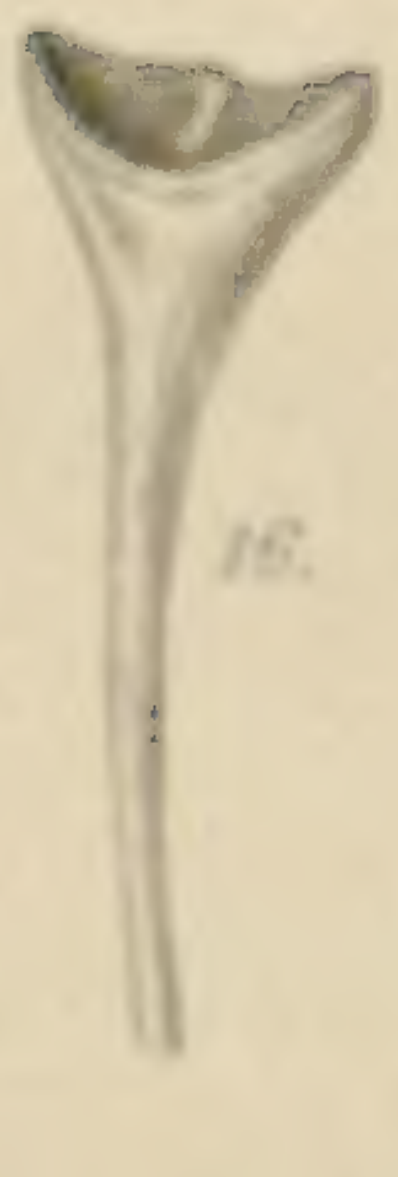
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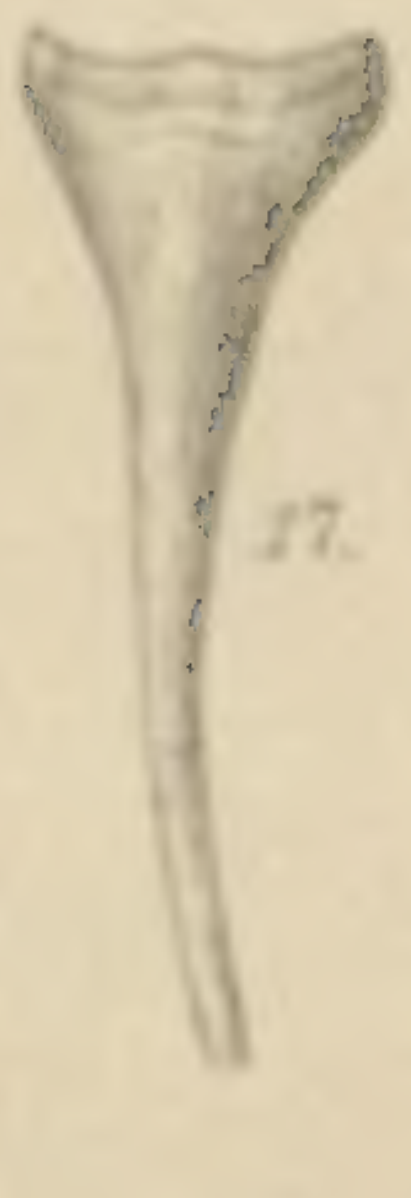
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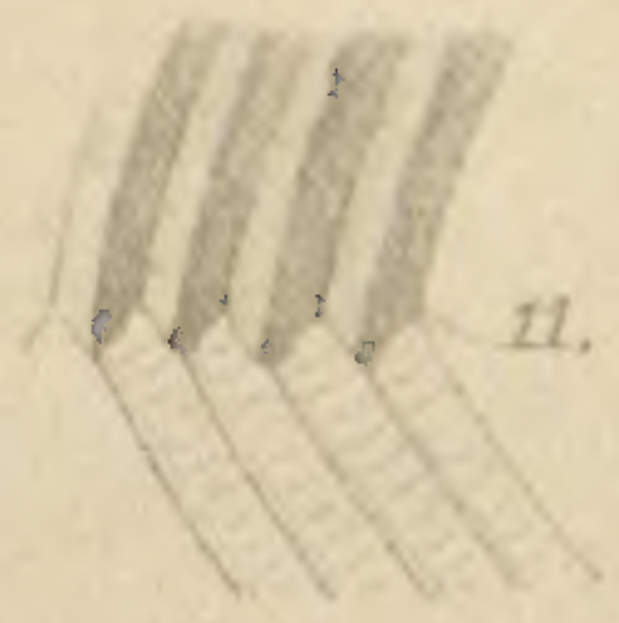
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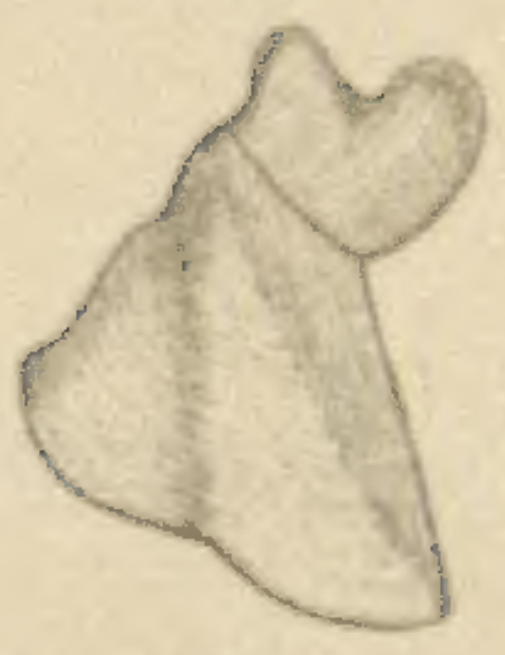
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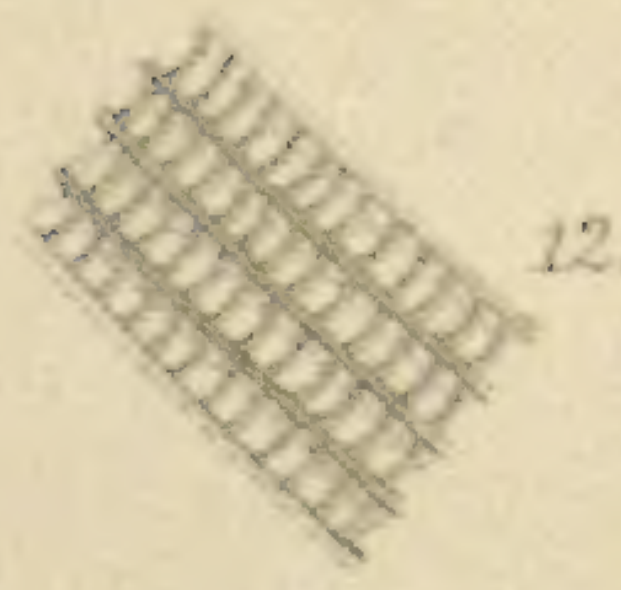
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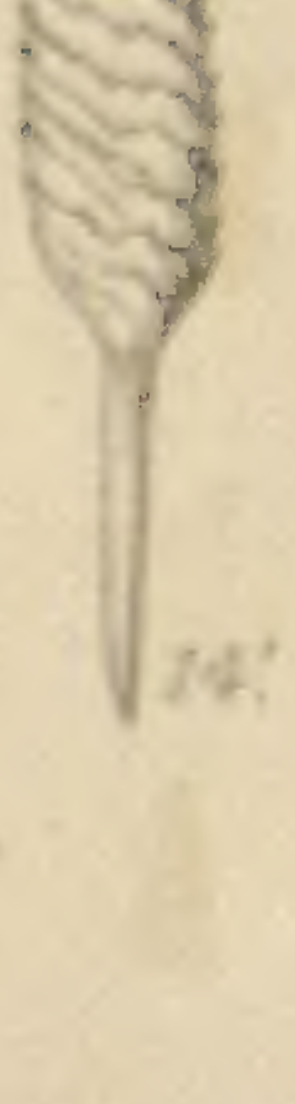
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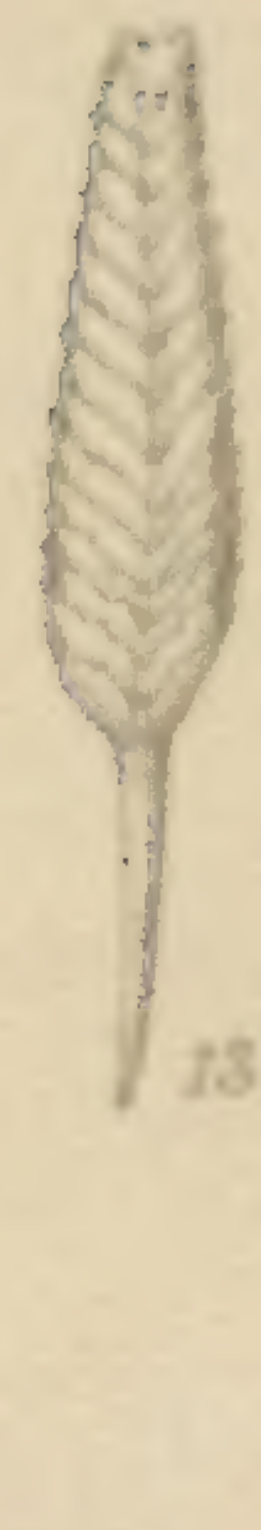
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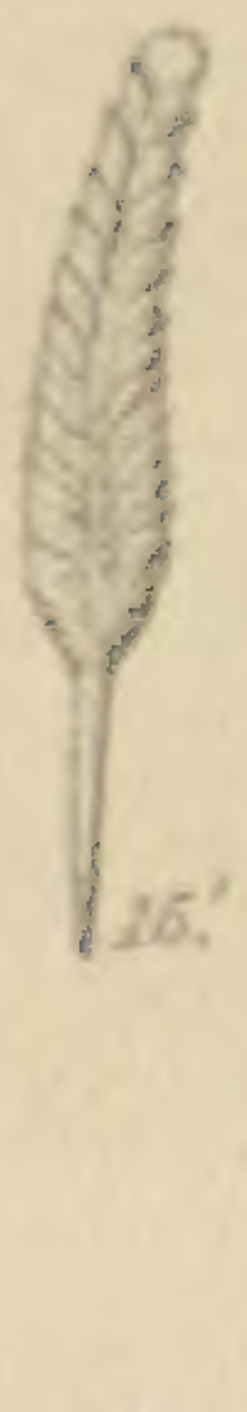
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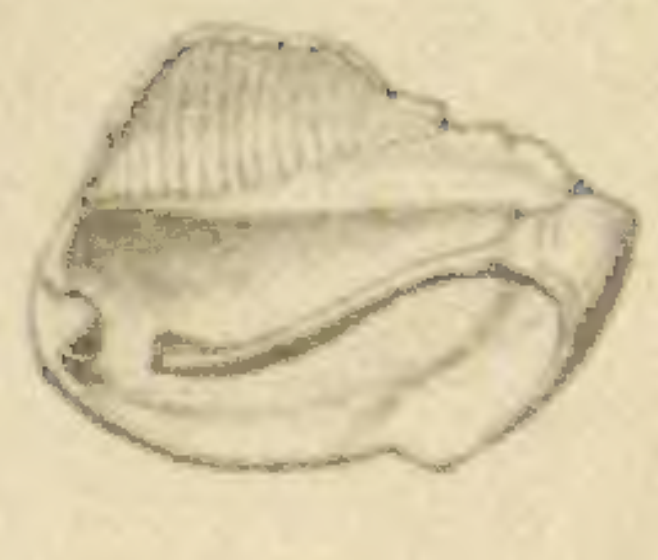
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DIRECTIONS

FOR

PLACING THE PLATES

OF

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END OF THE TWENTY-FIFTH VOLUME.

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